# Assessing the Macroeconomic Impact of HIV/AIDS in Uganda

## Phase II Report: Selected Studies

1. The impact of HIV/AIDS on poverty
2. Assessing sectoral vulnerability to HIV/AIDS
3. HIV costing, financing and expenditure
4. The demographic impact of HIV/AIDS
5. Macroeconomic linkages between aid flows, the exchange rate, inflation and exports

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## Abbreviations

| | |
|---|---|
| AIDS | Acquired Immune Deficiency Syndrome |
| ART | Anti-retroviral therapy |
| BoU | Bank of Uganda |
| CGE | Computable General Equilibrium |
| DTIS | Diagnostic Trade Integration Study |
| ETOs | Extra-territorial Organisations |
| GDP | Gross Domestic Product |
| GFATM | Global Fund for AIDS, Tuberculosis and Malaria |
| GOU | Government of Uganda |
| HIPC | Heavily Indebted Poor Countries |
| HIV | Human Immunodeficiency Virus |
| IEC | Information, Education and Communication |
| IMF | International Monetary Fund |
| MDGs | Millennium Development Goals |
| MoFPED | Ministry of Finance, Planning and Economic Development |
| MOH | Ministry of Health |
| MTCT | Mother to Child Transmission |
| MTEF | Medium Term Expenditure Framework |
| NACP | National AIDS Control Programme |
| NGOs | Non Governmental Organisations |
| NSF | National Strategic Framework |
| NSP | National Strategic Plan |
| ODA | Official Development Assistance |
| PEAP | Poverty Eradication Action Plan |
| PEPFAR | President's Emergency Plan for AIDS Relief |
| PMTCT | Prevention of Mother-To-Child Transmission of HIV |
| PRSPs | Poverty Reduction Strategy Papers - |
| REER | Real Effective Exchange Rate |
| STD | Sexual Transmitted Diseases |
| TASO | The AIDS Support Organisation |
| UAC | Uganda AIDS Commission |
| UN | United Nations |
| UNAIDS | Joint United Nations Programme on HIV/AIDS |
| UNASO | Uganda Network of AIDS Service Organisations |
| UNDP | United Nations Development Programme |
| UNICEF | United Nations Children's Fund |
| USAID | United States Aid for International Development |
| US$ | United States Dollar |
| WHO | World Health Organisation |

# Chapter 1: Evaluating the Macroeconomic Impact of HIV/AIDS in Uganda: Phase 2 – Selected Studies

## 1. Introduction

This report is the second in a series of reports on Evaluating the Macroeconomic Impact of HIV/AIDS in Uganda, commissioned by the Ministry of Finance, Planning and Economic Development (MoFPED) and the United Nations Development Programme (UNDP) in Uganda. Although there is awareness of the general economic impacts of HIV and AIDS in Uganda, little has been done to quantify these impacts, particularly the impact of alternative policies in dealing with the scourge. The lack of quantitative information has hindered macroeconomic planning and the formulation of an appropriate HIV/AIDS response. In particular, while there is awareness of the need to scale-up the response to HIV and AIDS, there is concern that the macroeconomic stability which Uganda has made over the past 15 years, could be lost. The result has been uncertainty over the level of investment that should be made in responding to HIV/AIDS in Uganda. There has also been a lack of understanding as to whether the benefits of a rapid scale-up of treatment would be primarily economic, social, or both. This study endeavours to fill that gap.

This study was conducted in three phases, as follows:

**Phase I**: Literature review from Uganda and the African region on existing micro economic and macroeconomic studies and models, detailed methodology and scope of work for phase two;

**Phase II**: A selected number of micro-economic studies/surveys;

**Phase III**: An aggregated macro-economic analysis, production and validation of report.

The draft Phase I Report, *Literature Review: The Macroeconomic Impact of HIV/AIDS,* was presented to a stakeholders workshop in August, 2007. Following comments received at the workshop, the report was revised and published in October 2007.

Phase II of the project involved conducting five mini-studies which provided essential inputs into the macroeconomic analysis work for Phase III. The mini-studies were as follows:

1. Modelling the household and poverty impact of HIV/AIDS.
2. Modelling of sectoral HIV-vulnerability/risk exposure.
3. HIV costing, financing and expenditure.
4. Preparation of demographic projections.
5. Analytical (econometric) studies on macroeconomic relationships between aid flows, inflation, exchange rates and exports.

This report encompasses the results of the above mini-studies, with each study covering one chapter of the report. This chapter gives a summary of the rationale and approaches used in each of the studies, and the accompanying results.

Phase III of the study consists of a modelling exercise to quantify the impact of HIV/AIDS on the Uganda economy, and of the impact of interventions related to the provision of Anti-retroviral Therapy (ART). The report for Phase III, which will be produced separately, contains the modelling results, conclusions regarding macroeconomic impact of HIV/AIDS in Uganda, and policy recommendations.

# 2. Summary of Results of Mini-studies

## Modelling of Household and Poverty Impact

The aim of this study was to model the impact of HIV/AIDS on household incomes and poverty levels. It utilises techniques used previously in studies of Swaziland, Zambia, Ghana, Kenya and Botswana, and is based on household level data (from nationwide household surveys) on incomes, expenditure and poverty status, and data on sero-prevalence that can be matched to the household data. The basic approach is to model the impact of HIV/AIDS on household income and expenditure, using information on sero-prevalence for different demographic categories to determine which individuals and households are HIV+. Poverty levels are then recalculated taking account of the simulated impact of HIV/AIDS.

### Summary of Results

The study finds that HIV/AIDS is likely to have a negative impact on poverty in the short-term. However, the impact is likely to be fairly small, raising the overall headcount poverty rate by only 1.4 percentage points (or by 5.2%). In absolute terms, the impact is greater in rural areas, where poverty rises by 1.6 percentage points, compared to urban areas (0.9 percentage points). However, because poverty rates are so much lower in urban areas, the proportionate impact on urban poverty is greater. The short-term poverty impact analysis models the effect of higher household expenditure on healthcare and funeral costs, as well as income losses due to the ill-health of breadwinners. Of these, the greatest impact comes from additional health-care expenditure. Estimates of the additional expenditure burden are drawn from international studies, and further research would be necessary to obtain Uganda-specific estimates of this impact.

The impact on poverty is also greater in regions with relatively low poverty rates. This is because in high-poverty regions, the majority of households are already poor, so HIV/AIDS pushes fewer households below the poverty line. When looking at the depth of poverty, however, (the degree to which households fall below the poverty line), HIV/AIDS has a greater impact in the rural areas as it pushes already poor households even further into poverty.

The estimated impact on poverty levels in Uganda is comparable with that found in other studies for Kenya, which has a similar HIV prevalence rate, but is much smaller than the impact in high-prevalence countries in Southern Africa.

The analysis also considered the long-term impact on poverty levels, which focuses on changed income levels (due to the death of breadwinners) and changed household sizes. These two effects counteract each other. There are also no health cost effects. Hence the long-term impact on poverty is smaller than the short-term impact.

While this analysis does not address the impact on poverty of Anti-retroviral therapy (ART) provision, the fact that additional health care costs are the main contributor to increased poverty levels indicates that ART provision would have a beneficial impact. This is because ART has a significant positive effect on health and well-being, and will therefore reduce health-related expenditure and

increase income levels. However, this will be offset to the extent that ART provision requires regular visits to health facilities, which has implications for both household expenditure and time available for work. Further research evaluating the level of health expenditure in households with HIV+ members and the impact of ART provision would therefore be worthwhile.

## Modelling of Sectoral HIV-Vulnerability/Risk Exposure

This analysis focused on the extent to which different sectors of the economy are vulnerable to the negative impacts of HIV prevalence amongst their workforces. It made use of information regarding the variation in HIV prevalence amongst demographic and occupational groups, and of the differing occupational and demographic structures in the workforce in differing industries.

Sectoral vulnerability was assessed in terms of various indicators:

- Reported sectoral HIV prevalence.
- Implied sectoral HIV prevalence according to occupational structures.
- The importance of skilled workers in production.
- The cost of educating workers who are lost to HIV/AIDS.

### Summary of Results

With regard to sectoral HIV prevalence as determined from the results of the Sero-Prevalence Survey, the most vulnerable sectors are Public Administration; Hotels & Restaurants; Sales and Fishing. While the Agricultural sector has a relatively low prevalence rate, it is by far the largest sector of the economy, and hence has the largest number of HIV positive workers in absolute terms. The Sero-Prevalence Survey sample was too small to provide prevalence rates for the Mining and Finance sectors.

The survey also provides information on HIV prevalence by occupation. Amongst working adults, there is some evidence that HIV prevalence varies across occupations. The prevalence rate is relatively high amongst Sales, Clerical and Service sector workers, who might generally be classed as semi-skilled. There is a slightly lower, but above average, prevalence rate for skilled professional and manual workers. The lowest prevalence rates are for the unskilled categories of manual and agricultural workers. These results confirm that unskilled workers have lower HIV prevalence rates than those of semi-skilled and skilled workers, which contrasts with the findings in South Africa.

The information on HIV prevalence by occupation was combined with information on the sectoral composition of the labour force in different sectors to further analyse sectoral vulnerabilities. A “proxy” HIV prevalence rate was calculated for each sector, combining occupational HIV prevalence rates with the occupational structure of the various sectors. The results are largely consistent with the earlier results, although the prominence of Public Administration is reduced. The proxy prevalence rate for Finance suggests that it is one of the most vulnerable sectors.

Sectoral vulnerability also depends on the contribution of different groups of workers to production and the ease with which they can be replaced should they fall sick or die. More skilled workers make a greater contribution to production and are more difficult to replace. Hence sectoral vulnerability depends on both prevalence rates and the proportion of skilled workers in sectoral employment. Taking both of these into account, the Education, Health, Finance and Public Administration sectors are the most vulnerable.

The study also takes into account the cost of educating workers in the different sectors. Using data on the level of education of workers in the different sectors, and estimates of the costs of education, as well as sectoral HIV prevalence rates, we can calculate the cost of replacing HIV+ workers as a percentage of the annual wage bill. The greatest burden is in the Hotels & Restaurants sector, which mainly represents the impact of relatively low wages in the sector combined with a high HIV prevalence rate. The next highest burdens are in Education; Public Administration; Health and Social Work, reflecting the high level of education of workers in these sectors and relatively high prevalence rates. While the Financial sector has both a relatively high prevalence rate and highly educated workers, it also has the highest wage levels of any sector so the relative cost of educating workers is reduced.

## HIV Costing, Financing and Expenditure

One of the major determinants of the macroeconomic impact of HIV/AIDS expenditure is the extent to which that spending is sourced domestically (from the government budget) or externally (from donor funds). A second important aspect is whether the funds are spent externally (on, for instance imported drugs) or domestically. Most of the concerns about the expenditure impact of HIV/AIDS stems from concerns that large amounts of external funds will flow into the country and boost aggregate demand, which will in turn cause inflation and real exchange rate appreciation (and loss of international competitiveness), and destabilise the macroeconomic achievements that have been secured over the past 15 years. However, this effect is reduced if the greater the proportion of spending is devoted to imported goods and services, as domestic aggregate demand will be affected less.

While there is some information on the sourcing of HIV/AIDS funding, there is little or no information on how the money is spent, or what it is spent on. The objective of this study was to track the flow of resources received through to spending, to determine what HIV/AIDS related funds are spent on, and in particular, whether that expenditure is on domestic or imported goods and services.

The methodology followed was to gather information from resource providers (donors and Governement of Uganda [GoU]) relating to the sources of funds, and from entities involved in spending those resources. Information was sought on the main categories of expenditure, and on whether that expenditure was mainly domestic or external. The emphasis was on tracking the main financial flows, rather than *all* financial flows. It is in the nature of an exercise such as this that information seems incomplete, but the objective is to isolate the main flows in order to ascertain the relevant macroeconomic magnitudes.

An instrument was developed to collect the necessary data from donors and implementing agents, and results were obtained from a range of financing and implementing agencies. However, it was not possible to get the data in a desirable consistent form due to variations in the quality of information across agencies. In particular, many agencies did not keep information in a form which could enable the disaggregation of spending into the categories required by the project, especially with regard to domestic versus external spending. Several agencies declined to provide the requested information, although the eventual coverage was considered extensive enough to provide useful and representative conclusions.

### Summary of Results

Information on HIV/AIDS-related spending over the period 2004/05 – 2006/07 was obtained from 19 institutions covering an estimated 60% of total spending over the relevant period. The results showed that nearly half of the total spending was devoted to treatment, primarily the provision of ART, at 47% of total spending, with salaries and allowances the next major component at 15%. The expenditure breakdown in turn suggests that around 60% of total spending was devoted to imported goods and services, with 40% on domestic goods and services. This significantly reduces the potential macroeconomic impact of aid inflows.

## Demographic Projections

Demographic projections under different scenarios are required for the macroeconomic modelling in Phase III. In this phase, demographic projections were generated by using the Spectrum model, which has been specifically developed for modelling the demographic impact of HIV/AIDS, and which has been used by the Uganda Bureau of Statistics (UBOS) and Uganda AIDS Commission (UAC). Projections were developed for the period up to 2025 (at least 15 years into the future, as specified in the ToR), covering the following four scenarios:

- No HIV/AIDS.
- HIV/AIDS without treatment interventions.
- HIV/AIDS with treatment interventions (ART) – How scenario.
- HIV/AIDS with treatment interventions (ART) – High scenario.

The demographic model was calibrated to a 1980 base (i.e., pre-HIV/AIDS). Projections were produced for a number of variables under the four scenarios:

- Total population (by gender and age group).
- Population deficit due to HIV/AIDS.
- Population growth.
- Number of HIV+ people.
- HIV prevalence.
- Number receiving ART.
- AIDS-related deaths.
- Life expectancy.

### Summary of Results

**Total Population**: by 2002, HIV/AIDS had caused the Ugandan population to be some 6% smaller than it would have been without HIV/AIDS, while by 2025 the difference would be 9%.

**Population Growth:** the main impact of HIV/AIDS was felt during the early 1990s, when prevalence rates were high. As prevalence rates fell owing to High ART use during the late 1990s, the population is estimated to have risen almost up to the growth rate projected for the "Without AIDS" scenario.

**Impact of ART Provision on the Population**: the provision of ART, even in the High ART scenario, only closes part of the population gap between the "No AIDS" and "with AIDS" scenarios. In the Low ART scenario, the population in 2025 is only 0.1% higher than in the "No ART" scenario, while in the High ART scenario, the population is 0.8% higher than in the "No ART" scenario. The reason for the apparently small impact of ART provision is that a large proportion of the impact on the total population was felt during the late 1980s and early 1990s, where high HIV-prevalence and death

rates had a permanent effect, making the population smaller. The projections also show that unless ART is widely provided, it pays little demographic dividend.

**HIV Population**: the number of people infected with HIV is estimated to have peaked at about 1.4 million in 1996, before falling slowly. Without ART, the number of HIV+ people would continue to decline through to about 2012, following which time it would start to rise again. This reflects a number of factors. First, even with a constant prevalence rate, if the population is growing then the number of those infected with HIV will rise. Second, there are indications that the prevalence rate has been slightly rising, thus reinforcing the upward trend in the numbers of HIV infected people. With ART, the increase in the numbers of HIV+ people is even more dramatic, especially in the High ART scenario. The rollout of ART increases the number of HIV+ people, as those who would have earlier died are now living longer. It is projected that by 2025, there will be 2.2 million HIV+ people under the High ART scenario, but only 1.8 million in the absence of ART.

**Number Receiving ART:** The number of people receiving ART continues to rise in both the Low and High ART scenarios, although much more dramatically in the latter. The number receiving ART in the High scenario is close to, but somewhat below, the projections contained in the National Strategic Plan (NSP). This may indicate that the model is under-projecting the number of HIV+ people, or that the NSP envisages earlier treatment of HIV+ people with ART than the protocols embedded in the Spectrum model. It is unlikely to reflect a faster rollout of ART in the NSP, as the High scenario in this model envisages a very rapid rollout of ART.

**AIDS-related Deaths**: the number of deaths as a result of AIDS is estimated to have been falling since the late 1990s, which reflects a decline in HIV prevalence. The number of projected deaths owing to AIDS is highly dependent upon the rollout of ART. Under the High ART scenario, the rapid rollout of ART initially dramatically cuts the number of deaths due to AIDS, although eventually the number rises again. In the medium term, ART leads to a significantly reduced death rate and hence improved life expectancy. Without ART (or in the Low ART scenario), the number of deaths is projected to decline much more slowly, reflecting only the earlier decline in prevalence.

**Life Expectancy**: by the late 1990s, life expectancy had fallen to an estimated 44 years, compared to an estimated 56 years without HIV/AIDS. With time, however, this gap drops, reflecting the decline in the HIV prevalence rate and, in the High ART scenario, the availability of treatment, which prolongs the survival times for HIV+ individuals. By 2025, life expectancy is projected to be 60 years in the "With AIDS" scenarios, compared to an estimated 64 years "Without AIDS.

## Analytical (Econometric) Studies on Macroeconomic Relationships

The main channels through which inflows of external donor assistance may impact on the economy are well known. These include:

- potential exchange rate appreciation due to foreign inflows;
- monetary expansion and inflation if these inflows are taken into reserves (to prevent exchange rate appreciation);
- fiscal costs and higher interest rates if reserves are sterilised (to prevent monetary expansion).

While the channels are well understood, there is less information regarding the magnitude of these relationships. The aim of this study is to quantify these transmission channels.

Two studies were carried out in order to address these issues:

- A study of the determinants of Uganda's exports (principally the real exchange rate, but also considering other factors as necessary).
- A study of the linkages between aid flows and inflation in Uganda.

## Summary of Results

**Real Exchange Rate and Exports:** This study attempts to quantify the relationship between the real effective exchange rate (REER) and exports, in order to provide insights into the possibility of an aid induced Dutch disease effect on the Ugandan economy; which is a current concern given the increasing aid flows to Uganda towards the control of HIV/AIDS. To accomplish this objective, the study estimated a model of determinants of six Ugandan exports (coffee, tea, cotton, fish, maize and flowers) using Vector Error Correction Analysis and quarterly data over the period 1994-2006. The findings did not indicate a relationship between the REER and total exports. However, the study did find that the REER would affect specific exports, namely, fish, flowers and cotton, which account for nearly a quarter of the total exports. Thus, for fish, flowers and cotton, the findings indicate a possible Dutch disease effect. However, since a possible Dutch disease effect would reduce supply of some exports, it would have negative implications for poverty reduction in the long run. This underscores the need to contain appreciation pressures that may arise from aid flows, which have played a big role in Uganda's poverty reduction programmes over the last decade. Finally, the findings indicate that weather (rainfall), terms of trade (TOT), and cost of capital also affect Ugandan exports, though, to varying degrees depending on the type of export.

**Aid Flows, the Exchange Rate and Inflation**: This study analyses the impact of aid flows to the Ugandan economy on prices and REER over the period July 1994 - June 2007, using Vector Autoregression (VAR). The study found that an increase in aid flow is associated with a long-term increase in the money supply. However, this does not lead to any long-term increase in prices or to real exchange rate appreciation, which suggests that the Bank of Uganda's (BoU) monetary policy and stabilisation strategy has been successful. In the short run, an increase in aid is associated with greater volatility in both prices and the REER, which could be damaging to private sector investment. Moreover, aid dependence leads to high transaction costs (interest costs) through sale of securities by the monetary authorities. This has negative implications for medium-term fiscal sustainability and domestic debt sustainability. The policy implication of these findings is, however, not for aid recipient countries to scale back the level of aid, but rather to strengthen capacity to avoid volatility in prices, money and financial markets, which is associated with inflows of aid. This could be achieved through strengthening monetary and exchange rate management by reducing the volatility of aid flows and increasing their predictability. Finally, given the high short-run adjustment costs faced by the public sector, a dollar at the margin may have a much higher (social) payoff if it is transferred directly to the private sector. This could be achieved by retiring domestic debt with the aim of lowering domestic interest rates and increasing availability of credit to the private sector.

# Chapter 2: The Impact of HIV/AIDS on Poverty

## 1. Introduction

While there has been a considerable amount of research on the macroeconomic impact of HIV/AIDS in various sub-Saharan Africa (SSA) countries, little analysis of its impact on the household level has been done. What has been done comprises a mixture of community-level case studies and economy-wide modelling of the household impact of HIV/AIDS, typically based on actual household survey data (see Jefferis *et al* 2007 for a discussion). This chapter aims at establishing the impact of HIV/AIDS on household poverty in Uganda, by modelling the household income and expenditure effects. The chapter employs a now well-established methodology first used in BIDPA (2000) and Haacker and Salinas (2006).

The chapter models the impact of HIV/AIDS on poverty in the absence of widespread public provision of ART. The intention is to contribute to the debate on the provision of ART, by providing estimates of one element of the costs of HIV/AIDS (the poverty impact), which can then be compared with the costs of providing ART.

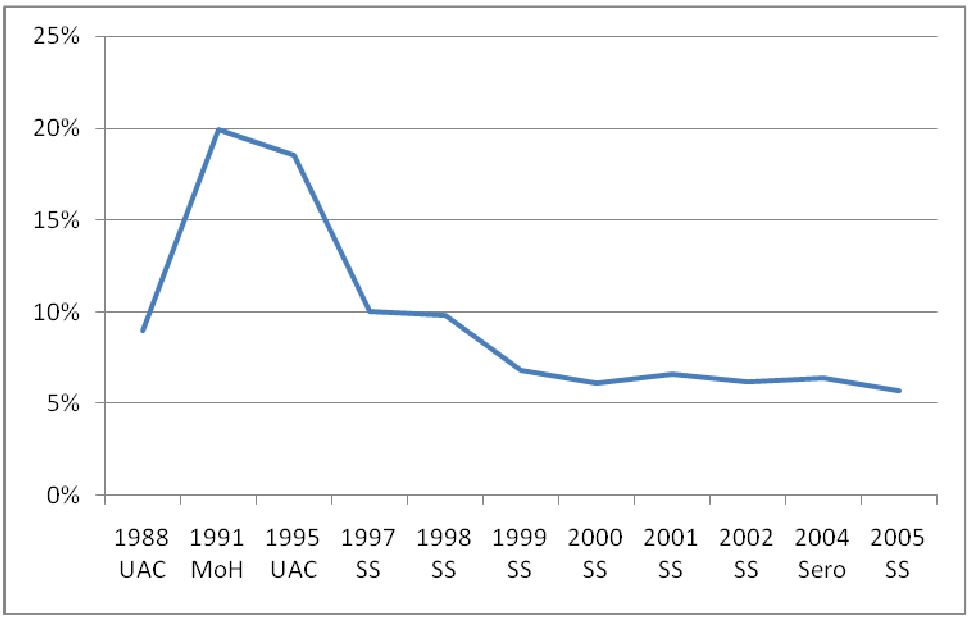
This chapter first presents information on HIV/AIDS and poverty in Uganda (Section 2), then introduces the modelling approach (Section 3), and presents results in Section 4.

## 2. Background: HIV/AIDS and Poverty in Uganda

### HIV/AIDS in Uganda

Uganda has been one of the countries hardest hit by the AIDS epidemic over the past 25 years. From only two known HIV/AIDS cases in 1982, the epidemic grew to reach a cumulative two million HIV infections by the end of 2000, and it is estimated that of these, around half of them have since died. It has been estimated that HIV/AIDS has had a direct impact on at least one in every ten households in the country, including the 884,000 HIV/AIDS orphans (UNAIDS, 2002). The Uganda AIDS Commission (UAC, 2001) gives similar, but slightly different figures, with a cumulative total of 2.2 million people infected with HIV since its onset, of whom about 800,000 people are estimated to have died of AIDS; about 1.4 million people were then estimated to be living with HIV/AIDS, of whom 100,000 were children under 15 years. The UAC gave a much higher figure of over 1.7 million children orphaned by AIDS. The risk of mother-to-child transmission of HIV (MTCT) was estimated at 15-25% (UAC, 2004)

**Figure 1: HIV Prevalence Rates, 1988-2005**



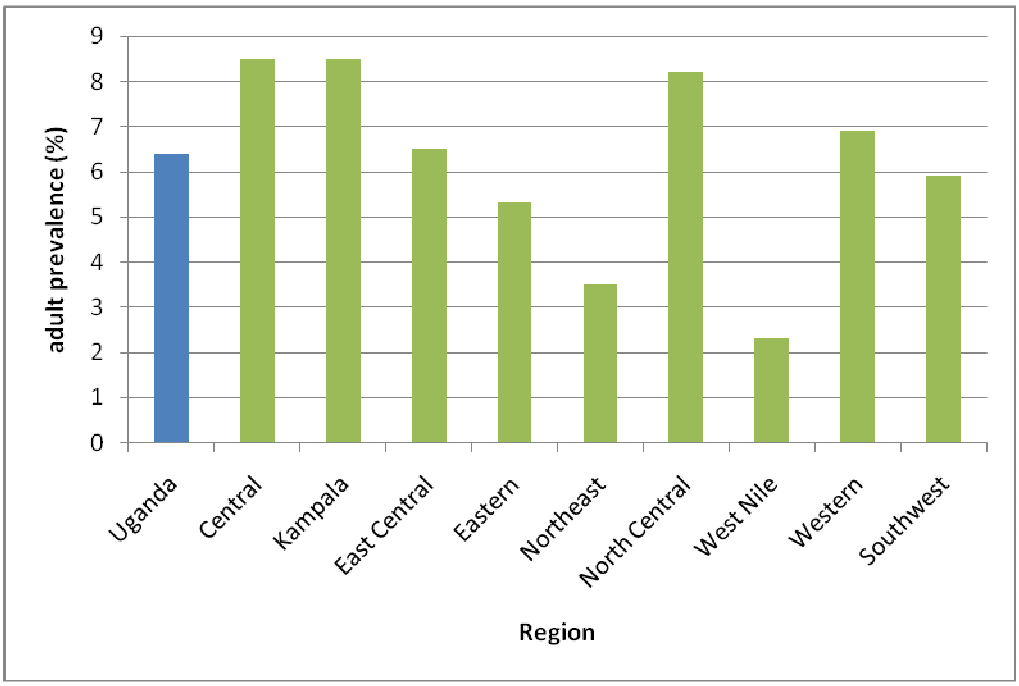

***Source**: UAC, MoH*

The dramatic reduction in the adult HIV prevalence rate reported in Uganda from around 20% in 1991 to 6.5% in the early 2000s, has been attributed to committed and sustained political leadership, early intervention, a strong focus on prevention, and a multi-sectoral approach (Okware, 2001). A crucial part in dealing with the consequences is also being played by civil society and households themselves. The Millennium Development Goal (MDG) for HIV/AIDS aims at halting and reversing the spread of HIV/AIDS by 2015. While Uganda had achieved this during the 1990s, recent developments have been less positive, and there are signs that the HIV-prevalence rate has been rising. For instance, the target in 2002 was to reduce HIV/AIDS prevalence to 5% by 2005, but it remained as high as 6.3% among the adult population (15-59 years) according to the 2004/2005 Sero-Behavioural Survey.

Despite doubts over the accuracy of some of the historical estimates of the prevalence rates as a result of constraints on HIV/AIDS reporting and uneven coverage of sentinel sites, there is no doubt that Uganda has succeeded in achieving a significant reduction in HIV prevalence over the last decade. This partly reflects the deaths of many people infected by HIV, but also a marked reduction in new transmissions.

Regional differences in HIV prevalence can easily be noted (see Figure 2). There are especially high prevalence rates in Central and Kampala districts (which could be due to relative economic prosperity) and the North Central region. The latter could be attributed to refugee settlements and internally-displaced persons (IDPs) in the area; as noted in the Poverty Eradication Action Plan (PEAP) (MoFPED, 2004). Key challenges include a relatively high HIV/AIDS prevalence in refugee-affected regions. Displacement and migrations from other countries increases the host communities' exposure to HIV/AIDS and other STDs. Redundancy, trauma, poverty and ignorance also contribute to the spread of such diseases.

**Figure 2: Adult HIV Prevalence Rates by Region**



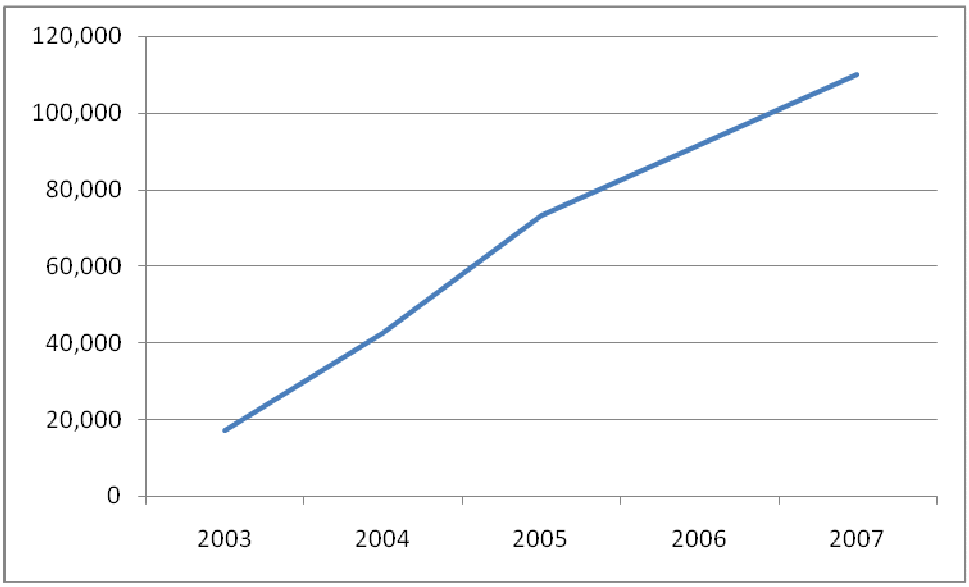

*Source: MoH, 2006*

Uganda's human resource planning has not been systematic and most sectors do not have a systematic way of accounting for the effects of HIV/AIDS on their staffing or of predicting future requirements of staff as a result of HIV. Also noted is that the effect of HIV/AIDS on productivity in the public service has not been properly estimated.

## Provision of ART

As a matter of policy, the GoU has decided to provide free treatment for HIV/AIDS through the provision of ART. This is to be accompanied by close monitoring of adherence to avoid the emergence of drug resistance. Recent data suggest that there has been an increase in the number of people receiving ART from 17,000 in 2003 to about 110,000 by mid 2007 as shown in Figure 3 below (UAC, 2007; MoH, 2007).

**Figure 3: Total Number of People on ART**




*Source: MoH, 2007*

Besides UAC planning to reduce the incidence rate of HIV by 40% by 2012, the national target is to increase equitable access to ART by those in need to 240,000 by 2012 (UAC, 2007).

The objective of scaling up ART roll-out further requires large-scale capacity-building activities, including additional training of health care workers and development of a stable health care infrastructure. This may further demand the re-allocation of public funds from other sectors.

The provision of ART falls under the government's general health financing programme, which has the following as the general guiding policy: "To develop and implement a sustainable, broad-based national health financing strategy that is geared towards:

i) Ensuring effectiveness, efficiency, and equity in the allocation and utilisation of resources in the health sector consistent with the objectives of the National Poverty Eradication Action Plan.
ii) Attaining significant additional resources for the health sector and focusing their use on cost-effective priority health interventions.
iii) Ensuring full accountability and transparency in the use of these resources.

The government plans to archive this through:

a) Progressive increases in the financing of the sector;
b) Focusing the use of public resources on the most cost-effective health services while protecting the poor and most vulnerable population and considering all gender-related health care concerns;
c) Developing and supporting alternative financing schemes such as user fees and health insurance without discriminating against the poor and vulnerable groups; and
d) Promoting the growth of private sector health initiatives.

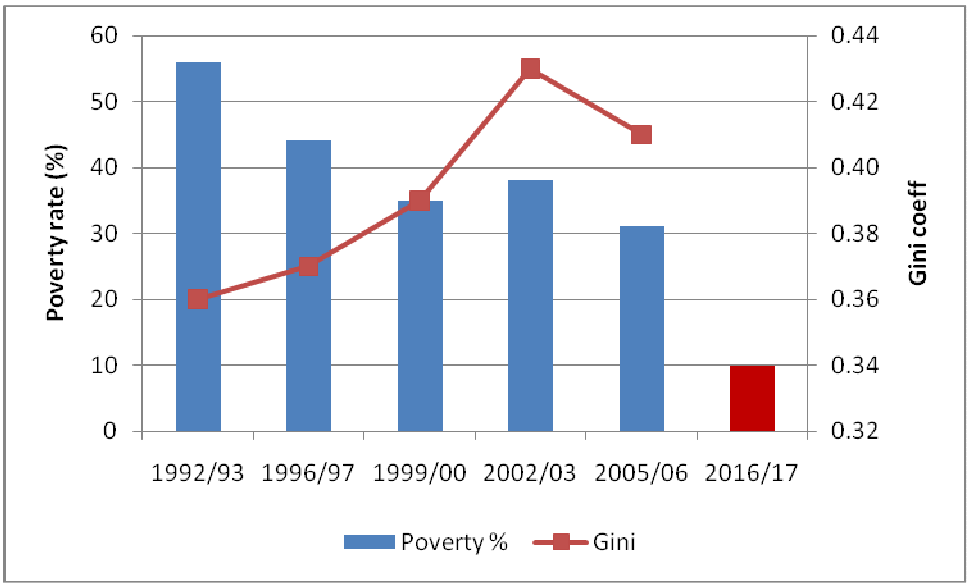
At a household level, HIV/AIDS infection has major implications for household expenditures and vulnerability to poverty. The cost of AIDS treatment (when paid out-of-pocket) competes with other crucial expenditures, such as food, shelter and, educational expenses. Even if treatment is subsidised, there are other costs associated with treatment such as cost of transport to the

distributing centre for treatment, costs of other medications, potential loss of income during times of illness, and diversion of funds toward healthcare (PEAP 2004).

## Poverty Levels

The estimated national incidence of poverty fell dramatically from 56% in 1992 to 35% in 2000, before rising again to 38% 2002. The most recent estimate for 2005/2006 is a national headcount poverty rate of 31%. By 2017, the target is to reduce the poverty rate to 10%. A number of policy interventions, including the Poverty Action Fund (PAF), have significantly improved social service delivery and its impact. However, less investment has gone to the productive sectors, particularly agriculture, where the majority of the poor derive their livelihood. Rural communities remain poorer than the urban population, with significantly higher poverty rates than in urban areas. Inequalities between socioeconomic groups and regions also persist. In 2002/2003, the overall poverty rate was estimated at 38%, with the lowest rate in the Central region and the highest in the Northern and Eastern regions (PEAP 2004).

**Figure 4: Trends in Poverty and Inequality**




*Source: PEAP 2004, Uganda Human Development Report 2007 and UNHS 2005/2006*

Despite the reduction in poverty levels, there has been a marked increase in inequality since 1997. The Gini coefficient, which measures inequality, rose from 0.36 in 1992/93, to 0.43 in 2002/03 although it has fallen to about 0.41 in 2005/06. The reasons for this pattern are thought to include a slowdown in agricultural growth during the past years, declines in farmers' prices, insecurity, high population growth rate and morbidity related to HIV/AIDS.

HIV/AIDS remains the leading cause of death within the most productive age ranges of 15-49. With HIV/AIDS prevalence rates stagnating between 6% and 7%, even though down from 18% in the mid-1990s, a further reduction in morbidity is dependent upon large-scale rollout of ART. Co-ordinated multi-sectoral action is required to reverse these trends, and mitigate the impact of HIV/AIDS (PEAP 2004).

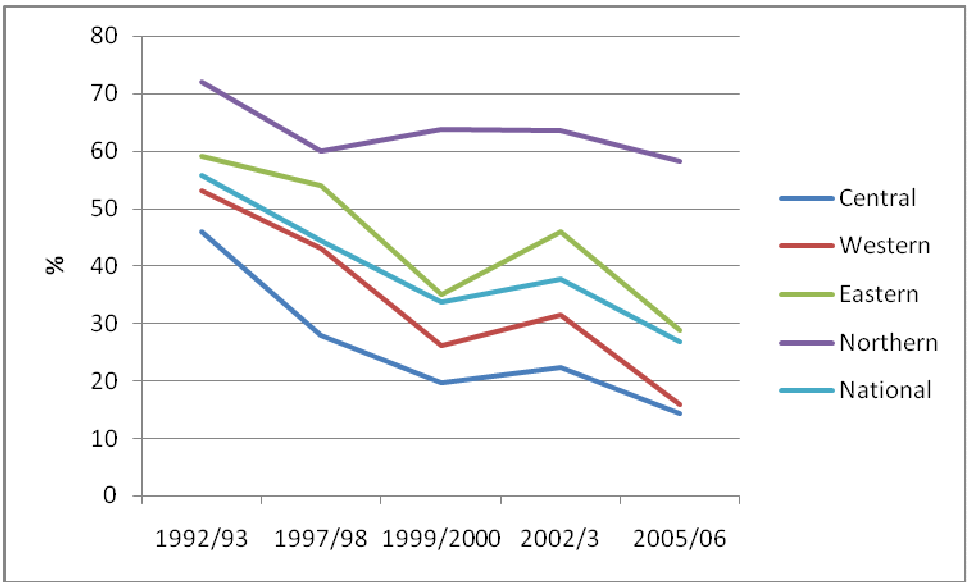
In trying to identify whom the poor are, PEAP 2004 concerned itself with four particular issues: regional inequalities; gender; occupational structure; and other disadvantaged groups.

While most parts of the country shared in the benefits of growth between 1992 and 2000, the North was left behind. The proportion of people in the North below the poverty line fell from 72% in 1992

to 60% in 1997/98, but rose again to 66% in 2000, and in 2005/06 Uganda National Household Survey (UNHS), it was estimated to be 60.7%.

The second-poorest region, the East, also suffered a significant deterioration, partly because of distress migration.

**Figure 5: Regional Poverty Rates**




*Source: PEAP 2004, UNHS 2005/2006*

## HIV/AIDS and Poverty

### Impact of HIV/AIDS

In Uganda, HIV/AIDS policies are emphasising the mitigation of the impact of HIV/AIDS and the universal provision of ART. It has been recognised (in PEAP 2004) that AIDS is a development issue:

- there is an interaction between HIV and poverty;
- at national level, HIV/AIDS robs sectors of both skilled and unskilled labour;
- it diverts scarce resources that could have been used productively in other sectors;
- AIDS increases absenteeism from work due to frequent illness of staff or/and nursing of sick family members leading to decreased productivity;
- the impact of HIV on labour supply has affected agricultural growth in some regions;
- there is a sharp increase in the proportion of investors reporting that AIDS is a constraint.

The epidemic also affects public sector service delivery, household savings and the intergenerational transmission of knowledge, and imposes a greater burden on the elderly while reducing their economic security. By killing primarily young adults, AIDS does more than destroy the human capital; it also deprives their children of the requirements (parents' care, knowledge, and capacity to finance education) to become economically productive adults.

At the micro level, HIV/AIDS affects particular social groups like orphans and vulnerable children (OVC), women, refugees and IDPs, who have been especially hit by the epidemic due to their disadvantaged position and low incomes. This is increasing the risk of children becoming street children, or a target for abuse and exploitation.

## Household Level: HIV/AIDS, Poverty and Inequality

The existing literature suggests that one of the greatest impacts of the HIV/AIDS epidemic is felt at the household level, where socio-economic factors combine with socio-cultural and epidemiological variables to influence prevalence (SSRC, 2004). It is the household unit that carries the greatest burden. Since socio-economic indicators, such as poverty and inequality, are both consequences and determinants of HIV/AIDS, they can interact with the epidemic at a household level to perpetuate a vicious downward cycle towards greater indigence.

Several studies have suggested that poverty increases susceptibility to contracting HIV/AIDS through several channels, including increased migration to urban areas; limited access to health care, nutrition and other basic services; limited access to education and information; sexual exploitation and gender inequality (Bloom *et al*, 2004).

Research evidence has also shown that the epidemic's influence on household living conditions derives in great part from the virus' specific demographic effects. Since HIV/AIDS is distinct from other diseases because it strikes prime-aged adults (the most productive segment of the economy 15-59 year old population), it changes the structure of the population (Barnett and Whiteside, 2002). HIV/AIDS makes the breadwinners fall ill and die, destroying the much-needed skills and depriving children of their parents. Barnett and Clement (2005) point out that the key to the social and economic impact of HIV/AIDS is that it is a slow moving virus and as a result it can affect three human generations.

The principal economic impacts experienced by affected households are loss of available income, as working adults fall ill or die or have to stop work to look after children and/or the ill as well as additional expenditure on health care and funerals (UNAIDS, 2004). Other effects include depletion of household assets (due to increased health expenditure, consumption needs and labour losses), lower productivity of subsistence labour and reduced availability of food. School enrolment may also decrease, as children are forced to dedicate time to labour and care-giving.

In a survey of 771 AIDS-affected households throughout South Africa, Steinberg *et al* (2002) documents the impoverishment and burden of care for family members. The epidemic deepens poverty among the already poor through loss of income and medical care costs, which absorb up to one third of household income. Children's schooling is also disrupted, especially among girls. This study also reveals a growing strain on extended family networks as households often send their children to live elsewhere, most often with relatives, worse still the already ageing grandparents.

Similar dynamics are described in Bachmann and Booysen's (2002/04) 18-month longitudinal study of rural and urban households in South Africa's Free State Province. The baseline study (2001-2002) finds that affected households are poorer than non-affected households, regardless of the poverty measure used. The incidence, depth and severity of poverty were worse among affected households, particularly among those who experienced illness or death. Some new findings of the follow-up studies are the insignificant differences in the impact on rural and urban households and the decline in income of unaffected households. The latter phenomenon suggests that the effects of the epidemic are not limited to "infected" households, but are giving rise to deepening poverty in the wider community.

Another survey carried out in South Africa (Oni *et al*, 2002), in the Limpopo Province, provides further evidence of how HIV/AIDS worsens poverty among households already living below the poverty line. One empirical result is that income received by affected households during the year 2000 was approximately 35% lower than that received by unaffected households while per capita

monthly income for the average affected household was about 31% lower than that of unaffected households. The study brings to light changes in household expenditure patterns where health and medical care as well as transportation and funeral expenditure increased among affected households, while spending on education, housing and remittances was reduced. For example, affected households increased their transportation costs by 4.7% and reduced expenditure on education by 7.3% and housing by 11.5%.

In a paper published in 2004, Wyss *et al* attempt to ascribe a value to the household level economic costs of HIV/AIDS described above. Their fieldwork in Chad, one of the poorest countries in the world, confirms that for most households, especially in the low-income settings, the consequences of AIDS are disastrous. Costs attributable to the epidemic during the period of illness up to death represent more than four times the annual Gross National Product (GNP) per head in Chad. Productivity losses make up 28% of total costs, while 56% of costs are on health related expenditure and 16% on funeral expenses.

## Long-term Household Costs of HIV/AIDS

There are also more indirect and long-term repercussions of the epidemic on households, that are not immediately apparent. Some go beyond the economic sphere, such as grief and increasing stress, which can negatively influence the psycho-social state of children. But there are also potential long-term economic costs. One intergenerational effect is that of diverting household resources from long-term assets to meet short-term needs, which influences household savings and investment decisions (Greener, 2004; ILO, 2004). Another loss is that of human capital, as fewer household resources – time, money, care, etc – are directed to children's mental and emotional development.

## Household Coping Strategies

When households that already live on the margins of survival are forced to absorb the 'shock' of HIV/AIDS, there is little else they can do but struggle to go on with whatever means possible. Coping strategies of affected households include utilising household savings, risk pooling and selling household goods. In some cases, families have no alternative but to sell productive assets (e.g. land, buildings, livestock, business stock, tools, etc), getting children out of school, and relocating from urban to rural areas more especially when the bread winner is the one that has died, thus further frustrating income generation potential and the possibility of recovering some of the losses incurred (Jayne, 2003/04). In this way, the situation of poverty is intensified and there is little opportunity for upward socio-economic mobility. Families rarely recuperate their initial level of economic well-being.

Robalino *et al* (2002) report that in Middle Eastern and North African countries, informal solutions to manage risks are diverse, ranging from family support and kinship ties to religious charitable organisations, but research has shown that they are usually insufficient to hedge against adverse shocks. Wyss *et al* (2004) find that AIDS cases in Chad rely more often on borrowing and selling of household assets for treatment, compared to non affected households. Across all households, income and savings are the most important sources for covering treatment costs.

Nampanya-Serpell's research among urban and rural households in Zambia (2002) finds that in the urban sample, the worst affected families are those in which the major breadwinner was the first parent to die. These families experienced a sharp drop in income and in most cases were forced to move out of their original home. Those who own a home and rent out part of it, those with an

educated adult female employed in the formal sector and those with wealthier relatives who can take in orphans are most protected from hardship.

# 3. Modelling the Household Level Impact of HIV/AIDS

## Methodology and Previous Studies

The most comprehensive effort to model the impact of HIV/AIDS on household poverty was carried out by Salinas and Haacker (2006). This modelled the impact in four SSA countries: Ghana, Kenya, Swaziland and Zambia, using methodology first used in Botswana by BIDPA (2000) and Greener, Jefferis & Siphambe (2000), and more recently by Jefferis *et al* (2006). The basic approach is to use pre-existing household survey data on income and expenditure, and then to hypothetically model the impact of HIV/AIDS on each household through income and expenditure effects, and hence on households' poverty status. HIV/AIDS is allocated randomly across individuals within households, with the probability of each individual becoming HIV+ matching prevalence data according to demographic, economic and social characteristics. This is most easily done if household-based Sero-Prevalence Survey data is available, but if not sentinel survey data can be used[1].

Once HIV status has been randomly assigned to individuals in the sample, based on the respective individual's socio-economic characteristics and the information available on HIV prevalence, this is then aggregated to household level. It is then used to simulate the impact of HIV/AIDS on income and consumption per capita, income distribution, and poverty rates.

A number of assumptions are required for this simulation and analysis. For HIV+ individuals, it was assumed that they live an average of ten years with the infection. It was further assumed that HIV/AIDS will impact economically on households by both increasing its required expenditures and by reducing its income through morbidity and mortality. The additional HIV-related expenditures assumed were health-care (assumed to be 25% for urban and 50% for rural households of incomes), and funeral expenditures (equivalent to four months of household expenditure). These expenditures were taken as an addition to their minimum expenditure defined in the poverty line.

This study also assumed that when a household member dies, his or her income is lost, and the average household income declines correspondingly. If a household member without income dies, the remaining income is divided among fewer household members. It is also assumed that there is a reduction of 15% in the income of any worker in the household who is HIV-infected and in the last two years before HIV-related death.

The HIV prevalence rates in the four countries show considerable variation, from 2.1% in Ghana to 31.4% in Swaziland. Salinas & Haacker's base case scenario results show that HIV/AIDS has a considerable negative impact on poverty and inequality, although it depends on exactly which measure is used. The greatest negative impact is on poverty measured at the US$ 1/day poverty line, whereas the impact on the US$ 2/day poverty line is much less, presumably reflecting the distributional characteristics of the disease. Also, in the countries with relatively low prevalence rates (below 10%, in Ghana and Kenya), average per capita incomes fall by less than 1%, whereas in the high prevalence countries the reduction in per capita incomes is much higher.

[1] Sentinel survey data were used for the first Botswana study and for Swaziland, while Sero-Prevalence Survey data were used for Ghana, Kenya, Zambia and the second Botswana survey.

### Table 1: Impact of HIV/AIDS on Poverty and Inequality in Selected Countries

| | Ghana | | | Kenya | | | Swaziland | | | Zambia | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Year 0 | Year 10 | Change (%) | Year 0 | Year 10 | Change (%) | Year 0 | Year 10 | Change (%) | Year 0 | Year 10 | Change (%) |
| **Adult HIV prevalence (%)** | 2.1 | | | 6.7 | | | 31.4 | | | 15.6 | | |
| **Income per capita (US$)** | 2.49 | 2.47 | -0.55 | 2.80 | 2.78 | -0.90 | 2.87 | 2.65 | -7.51 | 1.75 | 1.57 | -9.95 |
| **Poverty headcount (US$ 2/day,%)** | 66.38 | 66.38 | 0.003 | 58.92 | 60.53 | 2.7 | 59.90 | 64.00 | 6.9 | 79.17 | 81.48 | 2.9 |
| **Poverty headcount (US$ 1/day,%)** | 34.15 | 35.74 | 4.6 | 23.46 | 25.80 | 10.0 | 23.28 | 33.00 | 41.8 | 51.04 | 57.52 | 12.7 |
| **Gini coefficient** | 53.85 | 54.49 | 1.2 | 48.43 | 50.41 | 4.1 | 50.63 | 55.74 | 10.1 | 47.77 | 53.23 | 11.4 |

*Source: Salinas & Haacker, 2006*

The earlier study of the impact of HIV/AIDS on poverty and inequality in Botswana (Greener et al, 2000) found that HIV/AIDS would increase the poverty rate by 6 percentage points (pp) (from 37.7% to 43.7%). This 16% increase in poverty is consistent with the numbers for the high prevalence countries in the Salinas & Haacker study. The more recent Botswana study (Jefferis et al, 2006) found a smaller increase in poverty of around 3pp (from 33% to 36%). This smaller increase of 9% in the poverty rate partly reflected a lower HIV prevalence rate at the time of the later study, which itself stemmed from both success in containing HIV/AIDS and improved data (using household Sero-Prevalence Survey data rather than sentinel survey data)[2].

## Approach followed in this Study

In an effort to estimate the magnitude of the impact of HIV/AIDS on the household level, the key focus was its impact on poverty. The following procedure was taken to arrive at these estimates:

### Simulating HIV/AIDS

The analysis made use of person-level and household data from the 2005/06 UNHS. Using the HIV/AIDS Sero-Behavioural Survey data of 2004/05, each person in the UNHS data was assigned an HIV status in accordance to the age, sex, and region; level of education attained; as well as employment and marital status of the individual. This resulted in a pattern of infection which resembled very closely that observed in the Sero-Behavioural Survey. The person-level information was then aggregated back to household level in order to simulate the household impacts. Using certain assumptions about costs of HIV/AIDS to the affected households, the income and expenditure effects, we simulate the impact of HIV/AIDS on poverty, income and expenditure per adult equivalent under different scenarios. Note that there can be more than one HIV+ person in each household.

### *Key Assumptions*

This analysis combined the most recent sources of information about household structure, sources of income and expenditure patterns as well as HIV prevalence. The validity of the analysis rests on a number of key assumptions, as described below.

In the absence of ART, a person will die within 10 years from the time he/she gets infected with HIV. Ten years was taken as an average, since some people with low incomes, poor dietary habits and general poor health conditions may die before the 10 years, while others with better access to

[2] The 2004 Botswana AIDS Impact Survey measured a 24% adult HIV prevalence rate, compared to figures of around 35% from earlier sentinel surveys.

health facilities and food may live with HIV for more than 10 years. There are also differences in the way individuals respond physiologically to infection.

With or without HIV, household composition, structures and income sources change. Natural factors of population growth (death and birth) will still bring about population increase, and new households would be formed as people marry and get married, people will be growing and those currently not working will have started to work because of their advancement in age and this will add to household income while others will die leading to loss in income. All these have been assumed to roughly cancel out the impact of HIV/AIDS on household income distribution.

Within ten years, changes in the population distribution by age and sex are assumed to be insignificant, since changes in overall demographic structure are comparatively slow. The analysis here essentially assumes that the population structure will be in a steady state, apart from the effects of HIV/AIDS. This assumption isolates the impact of HIV/AIDS from the impact of other demographic changes taking place at the same time.

The economic impact of HIV/AIDS on the household is assumed to arise out of increased household expenditure and reduced income due to morbidity and mortality.

With regard to household expenditure, it is assumed that a person will begin to develop AIDS symptoms in his/her eighth year from the time of infection with HIV[3]. Hence, more frequent illnesses may be experienced, and this will increase medical and related household expenses (these include direct medical expenses such as consultations, laboratory tests, medication, hospital admission as well as indirect expenses such as transport costs, special dietary requirements, etc). However, the total expenditure in actual terms may depend on the household's income, although the proportion may fall in a given acceptable range. In Uganda where the health insurance is at its very minimal, most of these costs are financed from household's own sources, and some households may have to sell off assets and properties like land in order to meet these costs. These costs are assumed to increase by 50% in rural areas and 25% in urban areas due to the easiness or difficulties faced in accessing health services and differences in actual incomes[4].

The second associated cost is funeral-related expenses when a person dies of AIDS. These costs, which include feeding of many mourners for several days, and purchasing of other requirements like caskets, making announcements, transport, etc, tend to be high. Also, the actual amount spent will depend on the social status and level of income of the household that has lost a member, although the proportion may fall in a given range. It was assumed that funeral expenses would be equivalent to four months of household expenditure[5].

Since these expenditures are almost indispensable to the household, we reflect them as additions to their minimum expenditure or Poverty Datum Line (PDL) (following Salinas and Haacker, 2006). The approach taken here was to add these additional expenditure requirements to the package of basic needs of a household. In other words, there is an addition to the PDL of households affected by HIV/AIDS. The effect of this is to re-define the level of income which constitutes poverty and thus a family affected by HIV/AIDS is more likely to be classified as poor, due to these additional expenses.

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[3] Again, this does not mean that all HIV+ individuals will develop AIDS in the eighth year after infection. Some will develop it earlier, others later. The figure is intended as a representative average, and has been used in other similar studies.

[4] These parameters are the same as those used in Salinas and Haacker (2006), and derived from the detailed household study of the impact of HIV/AIDS in South Africa (Steinberg et al, 2002).

[5] As in Salinas & Haacker (2006).

These are short-term expenses, which apply in the period up to the tenth year when the HIV+ individual is assumed to die. The longer-term impact is therefore different, as the household no longer has to meet their expenditure requirements. This has the opposite effect to the additional expenditures described above, and makes it less likely that an HIV affected household will be classified as poor (as the household is now smaller and has lower expenditure requirements, and household income has to be spread across fewer members).

However, expenditure effects are not the only effects on household poverty levels. There are also income effects, which are discussed below.

### *Income Effects*

The incomes of individuals and households in general are also affected by HIV/AIDS through higher mortality and morbidity. In the short-term, while one or more household members are sick, household income will be reduced, because a breadwinner may be unable to work due to illness or the need to care for other household members[6][7].

In the long-term, the worst scenario that the household can face is that a breadwinner or an income earner dies of AIDS. This means that the income of the household goes down, and even though it is divided between fewer members, the per capita income of the household is likely to be lower because of the lost income. Some family members may respond by looking for jobs, and if they are successful this may lead to some or all of the lost income being replaced. Salinas and Haacker (2006), contend that having an efficient labour market which enables the unemployed to find jobs relatively quickly when others die of AIDS plays an important role in offsetting the negative impact of poverty on HIV/AIDS. However, in Uganda, this is likely to be a less important channel. The vast majority of the workforce is already occupied and unemployment is low, at 1.9% of the labour force in 2005/06, hence there are few people who can readily move into vacancies created when others die[8]. This is especially so in the case of skilled or professional jobs, when it is difficult to have the same skills, and even then, a person with skills does not wait for someone to die in order to look for a job. The majority of Ugandans (74% of the labour force) are employed in the agricultural sector, and reduced labour availability is likely to lead to reduced agricultural output and incomes, although there may be some scope for those who are underemployed (12.6% in the rural areas in 2005/06) to make up for some of the loss.

It is therefore assumed that a person who dies is hard to replace, and the lost income is foregone for that household. Other incomes earned thereafter would meet the day to day household expenditures since those households still have to live within limited income.

By comparison, if a household member without income dies, the income is simply divided amongst fewer household members, hence such a household is less likely to be poor and the per capita income of the household may increase.

## Indicators

The analysis calculates the values of a number of key indicators of poverty and inequality before and after the 10 year period. The indicators considered were as follows:

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[6] This study models only the income loss from breadwinners who become sick, due to lack of information regarding care relationships within the household.

[7] The study by Steinberg *et al* in South Africa found that two-thirds of AIDS-affected households experienced a fall in income.

[8] Data from UBOS *Report on Labour Market Conditions in Uganda*, December 2007.

Poverty levels are measured in the same way as they were in the UNHS 2005/06. Households are classified as poor if their consumption per adult-equivalent is less than the relevant adult-equivalent poverty line. We use household poverty, which is the percentage of households below the poverty line[9].

The household per-capita income is the household disposable income reported in the UNHS 2005/06, divided by the number of household members. It is important to note that this is not the same as per-capita Gross Domestic Product (GDP), and should be expected to be substantially lower. It was also adjusted for the HIV/AIDS cases using adjusted household income.

Another useful statistic is the income dependency ratio. This is the average number of people (within a household) who are supported by each household member who is employed and earning an income. This is usually considered to be a sensitive indicator of household poverty, and of the vulnerability of a household to the loss of an income earner. It was adjusted also for those with AIDS cases in the household given that their ability to earn an income is greatly hindered by frequent illnesses.

## Poverty Data

The UNHS dataset includes information on both households and the individuals within the household. In order to relate the individual and household data with regard to consumption, income and poverty levels, it is necessary to designate all household members with an adult-equivalent status. The adult-equivalent conversion factors specify what proportion of an adult's consumption level is required by household members of different ages and genders. The conversion factors used to derive household consumption levels and poverty lines are specified below:

**Table 2: Adult Equivalent Conversion Factors**

| Age group | Male | Female |
|---|---|---|
| <1 yr | 0.27 | 0.27 |
| 1 yr | 0.39 | 0.39 |
| 2 yrs | 0.45 | 0.45 |
| 3 yrs | 0.52 | 0.51 |
| 4 yrs | 0.57 | 0.56 |
| 5 yrs | 0.62 | 0.60 |
| 6 yrs | 0.67 | 0.63 |
| 7 yrs | 0.71 | 0.67 |
| 8 yrs | 0.75 | 0.70 |
| 9 yrs | 0.79 | 0.74 |
| 10 -12 yrs | 0.87 | 0.78 |
| 13-15 yrs | 0.97 | 0.83 |
| 16-19 yrs | 1.02 | 0.77 |
| 20+ yrs | 1.00 | 0.73 |

*Source: WHO (computed from the data of the UN Food and Agriculture Organisation. Energy and protein requirements report of joint FAO, WHO expert group)*

The following PDL (Table 3) estimates were used in this modelling exercise. These figures were compared with the adjusted household consumption data (UNHS 2005/2006) to derive the poverty status for each household.

[9] Note that poverty status (below the poverty line or not) is measured using consumption expenditure, which is generally considered to me more reliable than income. When the impact of income changes (due to HIV/AIDS) is modeled, it is assumed that consumption changes by the same amount as income.

**Table 3: Adult-equivalent PDL Estimates as used in 2005/2006 UNHS**

| Region | Shs |
|---|---|
| Central rural | 21,322 |
| Central urban | 23,150 |
| Eastern rural | 20,652 |
| Eastern urban | 22,125 |
| Western rural | 20,872 |
| Western urban | 21,800 |
| Northern rural | 20,308 |
| Northern urban | 21,626 |
| **National (average)** | **21,135** |

*Source: UBOS*

The poverty rates derived in this way are shown in Table 4 below. The overall poverty level at household level was about 27%. Northern Uganda had over half of its households (52%) classified as poor, followed by Eastern Uganda (29%). The proportion was lowest in Central region (14%) and Western region (16%)[10].

**Table 4: Poverty Rates by Region**

| Region | Poverty rate |
|---|---|
| Central | 0.14 |
| Eastern | 0.29 |
| Northern | 0.52 |
| Western | 0.16 |
| **Overall** | **0.27** |

*Source: Based on the UNHS 2005/2006 data*

# 4. Results

In estimating the impact of HIV/AIDS on household poverty levels, we considered a range of different impacts:

**Short-term impact:**

- Health and related costs.
- Funeral costs.
- Income effect.

**Long-term impact:**

- Income effect.
- Household composition effect.

## Short-term Impact

### Impact of Health and Related Costs

Under this scenario, rural and urban households were assumed to be facing different levels of additional cost burden. Following the precedent of similar exercises elsewhere, it was assumed that

[10] These figures are slightly lower than those reported in UNHS 2005/06 (UBOS 2007). This exercise was unable to replicate exactly the UBOS poverty calculations. However, the main purpose of this exercise is to model the change in poverty rates, not the absolute levels.

rural households will spend an equivalent of 50% of their monthly household consumption expenditure on HIV/AIDS-related health and other needs while the urban households would spend an equivalent of 25%. These costs were only applying to individuals that had lived with HIV for eight to 10 years, as this is when the impact of the illness becomes most severe. As discussed above, the impact was incorporated through raising the appropriate poverty line for the household.

Taking account of this impact only, HIV/AIDS-related health and other costs made the household poverty level to increase from 26.8% to 27.8%, i.e. an increase of 1pp in the poverty level. This effect was generally felt more in rural areas (1.2pp) than in urban areas (0.3pp). Also, the households in Northern region behaved differently from the rest of the regions. This could be attributed to the political disturbance that influenced their rural/urban settlement patterns other than the social-economic factors that operate in other regions. The Western rural households experienced a 1.7pp increase in poverty rates due to HIV/AIDS related health costs.

**Table 5: Changes in Poverty Level: Health Costs Impact**

| Region | % Without HIV/AIDS | | | % With HIV/AIDS | | | Change | | |
|---|---|---|---|---|---|---|---|---|---|
| | Rural | Urban | Overall | Rural | Urban | Overall | Rural | Urban | Overall |
| Central | 17.7 | 4.3 | 14.3 | 19.1 | 4.7 | 15.4 | 1.4 | 0.4 | 1.1 |
| Eastern | 33.4 | 11.8 | 28.8 | 34.6 | 12.1 | 29.7 | 1.1 | 0.2 | 0.9 |
| Northern | 57.5 | 33.4 | 52.4 | 58.2 | 33.4 | 53.0 | 0.7 | 0.0 | 0.6 |
| Western | 18.5 | 7.8 | 15.9 | 20.3 | 8.3 | 17.4 | 1.7 | 0.5 | 1.4 |
| **Overall** | **31.0** | **12.8** | **26.8** | **32.2** | **13.1** | **27.8** | **1.2** | **0.3** | **1.0** |

## Impact of Funeral Costs

The funeral costs scenario assumed that people with HIV/AIDS will not die until the 10th year of living with the virus. Funeral costs were estimated to be an equivalent of four months household consumption expenditure. Having this effect and ignoring other factors gives a smaller impact on household poverty. This could be attributed to the fact that funeral expenses are a one-off expense which are relatively small compared to overall household consumption. Generally, the increase in number of households moving into poverty as a result of funeral expenses only was less than 1pp for both rural and urban households. The social ties and community responsibility to support households that have lost family members protects such households from selling family assets such as land in order to cater for burial expenses. The shouldering of the burial costs tends to rest on friends and relatives of the bereaved household.

**Table 6: Changes in Poverty Level: Funeral Costs Impact**

| Region | % Without HIV/AIDS | | | % With HIV/AIDS | | | Change | | |
|---|---|---|---|---|---|---|---|---|---|
| | Rural | Urban | Overall | Rural | Urban | Overall | Rural | Urban | Overall |
| Central | 17.7 | 4.3 | 14.3 | 17.7 | 4.5 | 14.3 | 0.0 | 0.2 | 0.0 |
| Eastern | 33.4 | 11.8 | 28.8 | 33.6 | 11.8 | 28.9 | 0.1 | 0.0 | 0.1 |
| Northern | 57.5 | 33.4 | 52.4 | 57.6 | 33.4 | 52.5 | 0.1 | 0.0 | 0.1 |
| Western | 18.5 | 7.8 | 15.9 | 18.6 | 8.0 | 16.1 | 0.1 | 0.2 | 0.1 |
| **Overall** | **31.0** | **12.8** | **26.8** | **31.0** | **12.9** | **26.9** | **0.1** | **0.1** | **0.1** |

## Income Adjustment Effect

In this scenario, the assumption was that in the early years of HIV, the person is still effective in his/her work and there is no negative effect on income. The efficiency, however, begins to decrease in the eighth year to about 85%, then to 60% in the nineth year and finally to 10% in the 10th year of

HIV. This level of inefficiency is translated into reduced income by the same proportion. The lost income simply translates into reduced available money to consume by the same household. Assuming other factors remain constant, then the households with an HIV+ working member who has developed AIDS will face this challenge that will push it into poverty or more poverty if it was already poor.

The income adjustments were able to increase poverty levels among households in Central and Western regions by about 1pp, while those in North and Eastern region did not face such an impact. This could be attributed to the fact that the probability of a household member being in a gainful employment was higher in Central and Western region than in the Northern and Eastern regions. This meant that having an AIDS person that is working was more likely to be in Central and Western region. This further illustrates the regional imbalances in income and poverty distribution.

**Table 7: Changes in Poverty Level: Income Adjustment Effect**

| Region | % Without HIV/AIDS | | | % With HIV/AIDS | | | Change | | |
|---|---|---|---|---|---|---|---|---|---|
| | Rural | Urban | Overall | Rural | Urban | Overall | Rural | Urban | Overall |
| Central | 17.7 | 4.3 | 14.3 | 18.4 | 5.0 | 15.0 | 0.7 | 0.7 | 0.7 |
| Eastern | 33.4 | 11.8 | 28.8 | 33.7 | 12.1 | 29.1 | 0.3 | 0.2 | 0.3 |
| Northern | 57.5 | 33.4 | 52.4 | 58.0 | 33.7 | 52.9 | 0.5 | 0.3 | 0.4 |
| Western | 18.5 | 7.8 | 15.9 | 19.1 | 8.3 | 16.5 | 0.6 | 0.5 | 0.6 |
| **Overall** | **31.0** | **12.8** | **26.8** | **31.5** | **13.3** | **27.3** | **0.5** | **0.5** | **0.5** |

## Income and Expenditure Effects Combined

In this scenario, the health and funeral costs effects were incorporated through a higher poverty line while the income adjustments affected disposable income for household consumption. Incorporating all these factors in the model made the household poverty level increase from 26.8% to 28.2%, which is a 1.4pp increase. This was more felt in Central and Western regions, with much smaller effects in the Eastern and Northern regions, as can be noted in Table 8. Rural households were more effected (1.6pp) than urban households (0.9pp). It is clear that the simple headcount of households that are poor or not shows that regions with higher poverty rates (Northern and Eastern regions) experienced less increase in head count of poor households than those with lower poverty rates (Central and Western regions). This will be clarified further in the estimations of the poverty gap (P1) and the severity of poverty (P2) which help to measure the depth of poverty. The overall magnitude of the changes in poverty levels (5.2% nationally) is comparable with that found by Salinas and Haacker (2006) for Kenya, with a similar HIV prevalence level, which varied between 2.7% (for a US$ 2/day poverty line) and 10% (for US$ 1/day).

**Table 8: Poverty Levels Incorporating Income Adjustments, Health and Funeral Costs Effect**

| Region | % Without HIV/AIDS | | | % With HIV/AIDS | | |
|---|---|---|---|---|---|---|
| | Rural | Urban | Overall | Rural | Urban | Overall |
| Central | 17.7 | 4.3 | 14.3 | 19.9 | 6.0 | 16.4 |
| Eastern | 33.4 | 11.8 | 28.8 | 34.7 | 12.1 | 29.8 |
| Northern | 57.5 | 33.4 | 52.4 | 58.3 | 34.0 | 53.2 |
| Western | 18.5 | 7.8 | 15.9 | 20.5 | 8.7 | 17.7 |
| **Overall** | **31.0** | **12.8** | **26.8** | **32.6** | **13.7** | **28.2** |

**Table 9: Changes in Poverty Levels (percentage points and %)**

| Region | Change (pp) | | | Change (%) | | |
|---|---|---|---|---|---|---|
| | Rural | Urban | Overall | Rural | Urban | Overall |
| Central | 2.3 | 1.7 | 2.1 | 12.4% | 39.5% | 14.7% |
| Eastern | 1.3 | 0.2 | 1.0 | 3.9% | 2.5% | 3.5% |
| Northern | 0.8 | 0.6 | 0.7 | 1.4% | 1.8% | 1.5% |
| Western | 1.9 | 0.9 | 1.7 | 10.8% | 11.5% | 11.3% |
| **Overall** | **1.6** | **0.9** | **1.4** | **5.2%** | **7.0%** | **5.2%** |

## Long-term HIV/AIDS Impact

As already pointed out in the assumptions, the major factor considered was that all people who are HIV+ will die by their 10th year, and households will therefore lose incomes earned by such members who are working. In the long-run, the impact of funeral and health costs, which are transient, will have passed. However, the effect of lost income from working household members who die will be permanent. Also considered was the fact that the size of households will be reduced by the number of deaths in that household, and hence the total adult equivalent value of that household will change.

Taking account of these combined effects (income and household composition), poverty rates are estimated to rise from 26.8% to 27.3%, an increase of 0.5pp, with similar changes in urban and rural households.

**Table 10: Long-term Changes in Poverty Level: Income Adjustments due to Death of HIV+Iincome Earners**

| Region | % Without HIV/AIDS | | | % With HIV/AIDS | | | % Change | | |
|---|---|---|---|---|---|---|---|---|---|
| | Rural | Urban | Overall | Rural | Urban | Overall | Rural | Urban | Overall |
| Central | 17.7 | 4.3 | 14.3 | 18.4 | 5.0 | 15.0 | 0.7 | 0.7 | 0.7 |
| Eastern | 33.4 | 11.8 | 28.8 | 33.7 | 12.1 | 29.1 | 0.3 | 0.2 | 0.3 |
| Northern | 57.5 | 33.4 | 52.4 | 58.0 | 33.7 | 52.9 | 0.5 | 0.3 | 0.4 |
| Western | 18.5 | 7.8 | 15.9 | 19.1 | 8.3 | 16.5 | 0.6 | 0.5 | 0.6 |
| **Overall** | **31.0** | **12.8** | **26.8** | **31.5** | **13.3** | **27.3** | **0.5** | **0.5** | **0.5** |

## HIV/AIDS Impact on Poverty Gap and Severity Indices

The analysis of the impact of HIV/AIDS on household poverty did not stop at the headcount indices showing the number who are poor. It proceeded to assess the poverty gap and the severity of poverty created by the pandemic. This is because the headcount fails to show the depth and severity of poverty created under the above scenarios. It shows the number of households that were falling below the poverty line under the different scenarios, but does not tell us how poor the poor are, as it remains unchanged when the poor become poorer under the different scenarios. Ideally, poverty measures should fall as the living standards of poor households rise or when income is transferred from a non-poor household to a poor household (even if the poverty status of both remain unchanged). The modelling therefore looked at the distribution of income among the poor as well as the incidence of absolute poverty.

The additional poverty indicators calculated were P1 and P2, for the different scenarios discussed above. P1 is the average poverty gap in the population (the amount by which household consumption falls below the household poverty line) expressed as a proportion of poverty line (PDL). For example if P1 = 0.3, it means that the average aggregate deficit of the poor relative to the

poverty line, when averaged over all households (poor and non poor households), represents 30% of the poverty line.

P2 on the other hand is a distributionally sensitive index that can detect income (or expenditure as a proxy of income, as in our case where expenditure was used) among the poor. P2 measures the square of the poverty gap, and hence gives more weight to households far below the poverty line. This measure would increase in the event of a transfer of income from a poor to a less poor household, even if both are below the poverty line, whereas P1 would be unchanged by such a transfer.

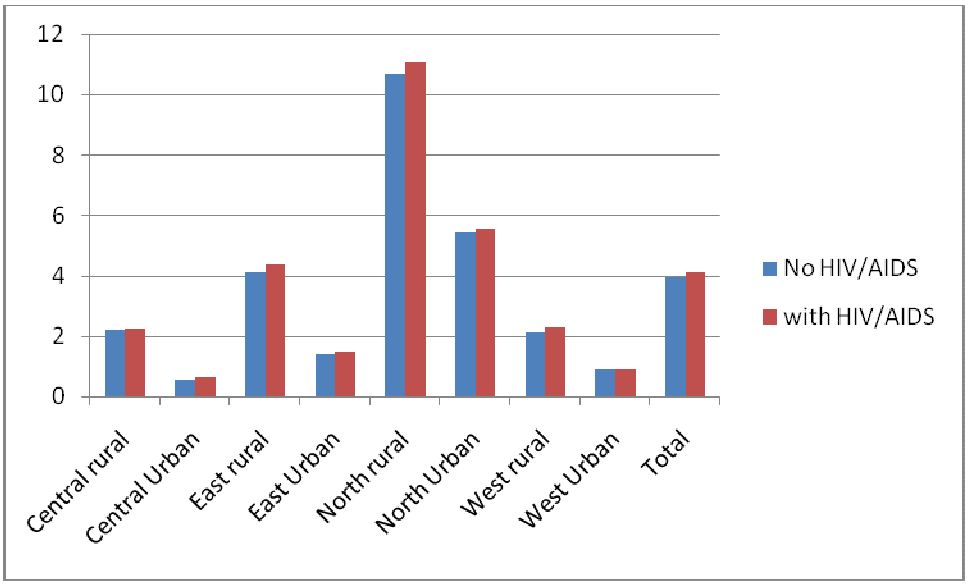
Looking at the different short-term impact scenarios, there is clear evidence that the poverty gap has increased due to HIV/AIDS and severity of poverty has also worsened. However, the impact has been different for different regions and whether the household is in a rural or urban area.

**Table 11: The Effect of Different Scenarios on the Poverty Gap (P1) and Severity (P2)**

| | **No HIV** | | **All factors** | | **Health costs** | | **Funeral costs** | | **Income adjustment** | |
|---|---|---|---|---|---|---|---|---|---|---|
| | **P1** | **P2** | **P1** | **P2** | **P1** | **P2** | **P1** | **P2** | **P1** | **P2** |
| Central rural | 5.27 | 2.19 | 5.34 | 2.25 | 5.31 | 2.22 | 5.28 | 2.20 | 5.30 | 2.21 |
| Central Urban | 1.20 | 0.57 | 1.27 | 0.65 | 1.22 | 0.59 | 1.22 | 0.59 | 1.25 | 0.62 |
| East rural | 9.89 | 4.13 | 10.13 | 4.35 | 10.10 | 4.28 | 9.92 | 4.15 | 9.96 | 4.21 |
| East Urban | 3.62 | 1.41 | 3.68 | 1.47 | 3.64 | 1.43 | 3.62 | 1.41 | 3.66 | 1.45 |
| North rural | 22.01 | 10.68 | 22.37 | 11.08 | 22.27 | 10.91 | 22.03 | 10.71 | 22.15 | 10.88 |
| North Urban | 11.96 | 5.44 | 12.06 | 5.57 | 12.13 | 5.57 | 11.96 | 5.44 | 11.92 | 5.46 |
| West rural | 5.35 | 2.10 | 5.58 | 2.31 | 5.50 | 2.21 | 5.38 | 2.12 | 5.46 | 2.20 |
| West Urban | 2.35 | 0.90 | 2.35 | 0.90 | 2.35 | 0.90 | 2.35 | 0.90 | 2.35 | 0.90 |
| **Total** | **8.86** | **3.95** | **9.04** | **4.13** | **9.00** | **4.05** | **8.88** | **3.96** | **8.93** | **4.03** |

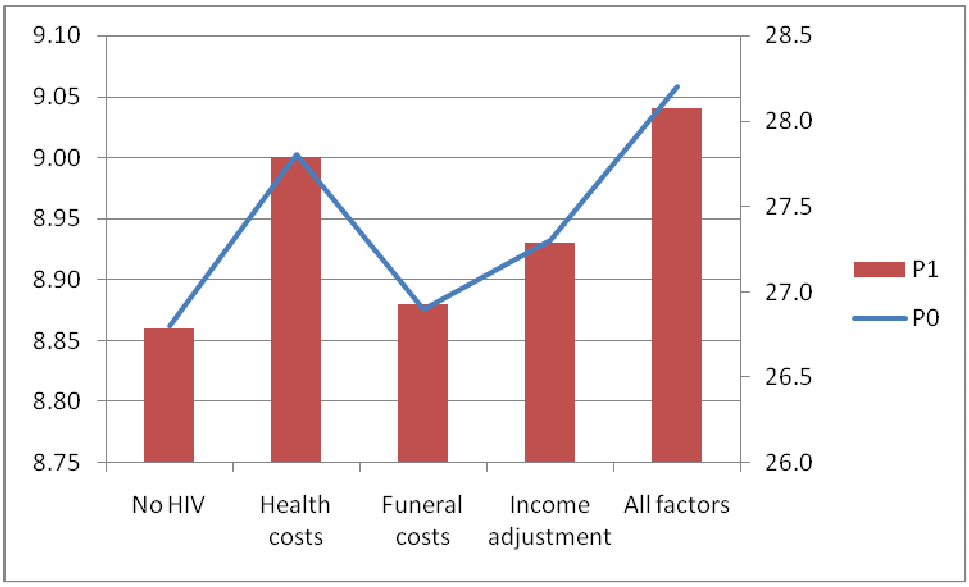
From Table 11 and Figure 6, it is clear that households in Northern region were more sensitive to any scenario in terms of widening the poverty gap than any other region. This was more so pronounced among the rural households. This was followed by the Eastern region. The Central and Western regions were not having a big shift in the poverty gaps (P2) for the different scenarios. Indeed, regions with higher poverty rates tended to show a bigger gap when HIV/AIDS impact was introduced. The poor households were becoming poorer due to a slight increase in household expenditure or loss of income.

**Figure 6: Change in P2 Values as a Result of HIV/AIDS**



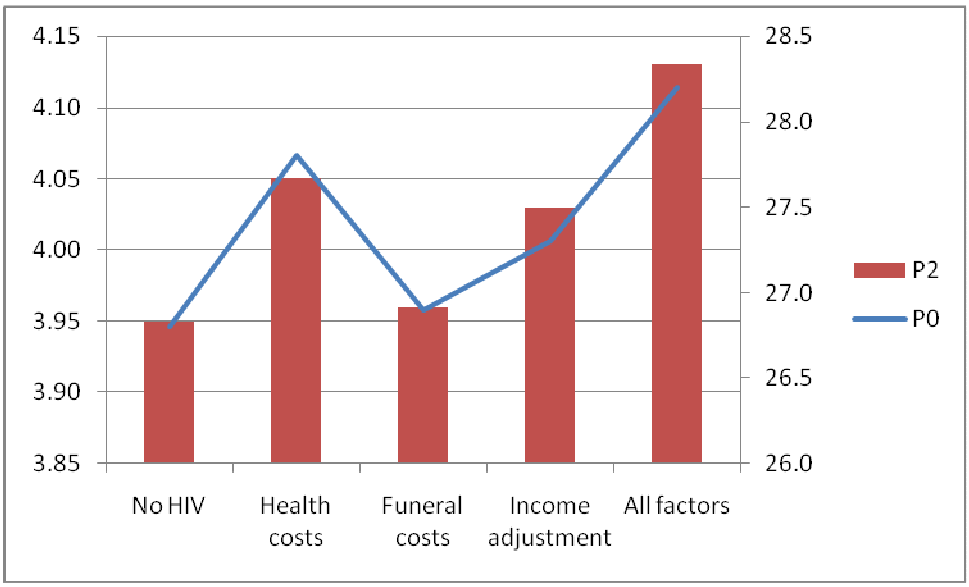

The different scenarios caused different levels of impact on poverty gaps as summarised in Figure 7. The scenario that caused such a big gap in poverty was health costs (9%) and reduced incomes due to AIDS (8.93%) while the funeral costs were the least (8.88%) in widening the poverty gaps. Putting all these issues together, the poverty gap jumped from 8.86% to 9.04%.

**Figure 7: Effects of Different Scenarios on Poverty Gap**




Looking at the severity of poverty caused by the different scenarios, from Table 11 and Figure 8, it is clear that the severity of poverty is increased by the HIV/AIDS epidemic among the households affected. Individually, health costs (+0.1 percentage points) and lost incomes (+0.08 pp) contribute greatly to this problem while funeral costs' effects are minimal (+0.01 pp). In general, all these factors combined made the severity of poverty jump from 3.95% to 4.13% .

**Figure 8: Poverty Rates and the Severity of Poverty**

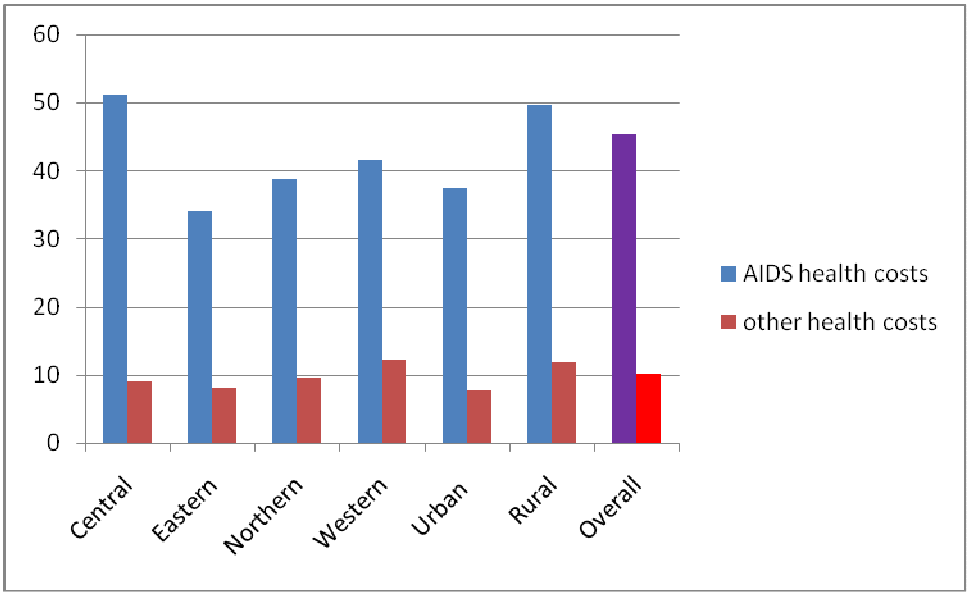



## Further Understanding of Health Costs

It has been persistently discussed that HIV/AIDS-related health costs are pushing households either into poverty or deeper into poverty for those that are already poor (as measured by the P0, P1 and P2 indicators). Because of this, an analysis of the actual composition of health costs in relation to the total household consumption was computed and illustrated in Figure 9.

Without HIV/AIDS, the health costs at household level were about 10% of all household consumption expenditure. Factoring in HIV/AIDS, for those households, the health and related costs would then jump to 45% of household consumption expenditure. This is felt more in rural areas than in urban areas. Such an increase in the health costs may be compounded by reduced incomes, hence other necessities of the household are either ignored or reduced. This then pushes the household into more poverty.

**Figure 9: Contribution of Health Costs to total Household Consumption for HIV and no-HIV Scenarios (%)**



# 5. Conclusions

It is evident from the above modelling that HIV/AIDS is likely to increase household poverty levels. In absolute terms rural households are more affected than the urban households, with a 1.6pp increase in headcount poverty rates. In proportionate terms, however, urban households are more affected than rural households.

Regions with high poverty rates tend to experience a smaller impact in terms of increased poverty, simply because a high proportion of households are already in poverty anyway regardless of HIV/AIDS. Both proportionately and in absolute terms, it is the better-off regions with lower poverty rates that experience a larger impact. In general, at the HIV prevalence rate of 6.3%, its impact on household poverty rate was estimated to be an increase of 1.4pp. The magnitude of the impact of poverty is comparable with that estimated for Kenya.

The modelling has shown that the major impact on poverty comes from HIV/AIDS health-related costs (1% increase in headcount poverty), especially in rural households. Other modelled impacts are smaller, with loss of income due to AIDS contributing 0.5% while funeral costs contributed only 0.1%. However, the impact of health costs on household expenditure is derived from survey work in South Africa, and may not be accurate in Uganda; hence a more appropriate estimate of poverty impact could be obtained from a Uganda survey of expenditure patterns in households with HIV+ members. This is both a limitation of this study, and an indication of where further research is needed.

The long-term impact of HIV/AIDS on household poverty rate was estimated to be smaller than the short-term impact, at about 0.5%. This is because in the long-term, once household members have died, the household does not bear additional health costs.

Other than the increase in poverty rate (head count index P0 which shows the number of households living below the poverty line), the poverty gap (P1) measurements revealed that HIV/AIDS makes the position of poor households even worse since they are pushed deeper into poverty. The scenario that had such a big impact as measured by P1 were health costs due to AIDS, and to some extent loss of income due to the same while the funeral costs had the lowest effect of pushing households into more poverty. The average poverty gap P1 index for all the scenarios combined was estimated to be 9.04%, up from 8.86%.

The above effect of HIV/AIDS on poverty was further confirmed by the distributionally sensitive index P2 by showing the distribution of the income among the poor. Still the health costs and income adjustments had a higher effect in P2 as opposed to funeral costs. HIV/AIDS made the P2 jump from 3.95% to 4.13%.

While this analysis does not address the impact of ART provision on poverty, the fact that additional health care costs are the main contributor to increased poverty levels indicates that ART provision would have a beneficial impact. This is because ART has a significant positive effect on health and well-being, and will therefore reduce health-related expenditure and increase income levels. However, this will be offset to the extent that ART provision requires regular visits to health facilities, which has implications for both household expenditure and time available for work. Further research evaluating the level of health expenditure in households with HIV+ members and the impact of ART provision would therefore be worthwhile.

# Chapter 3: Assessing Sectoral Vulnerability

## 1. Introduction

Phase I of the study reviewed the extent to which the impact of HIV/AIDS varied across different business sectors. This drew upon different types of research, including firm level surveys of HIV-related impacts and costs, sectoral level modelling (such as Computable General Equilibrium (CGE) modelling), and sectoral analysis of occupational and demographic structure of the labour force.

A study of firm level impact in South Africa (BER/SABCOHA, 2005) found that the most badly affected sectors were Mining, followed by Manufacturing and Transport. The impact depends on company size, skill levels and location. Small and medium enterprises (SMEs) note fewer impacts than medium and large companies, while companies with predominantly unskilled and semi-skilled workers note a much greater impact than those employing mainly highly skilled workers.

A range of actual and potential impacts on business are identified below.

- Reduced labour productivity and/or increased absenteeism (especially in Mining, Manufacturing, Transport and Financial services);
- Higher turnover, recruitment and training costs, and loss of experience and skills of workforce (Mining, Manufacturing and Transport);
- A smaller impact in retail, wholesale, construction;
- Increased labour demand, including over-staffing in key positions to avoid disruption to production;
- Some movement towards more capital intensive production techniques (Mining, Manufacturing);
- Reduced profitability, but little impact on prices.

A second assessment of the sectoral impact of HIV/AIDS in South Africa (USAID/BER 2006) combined macroeconomic impact analysis with sectoral impact analysis. The latter included an assessment of sectoral risk, through both the supply side and demand side impact of HIV/AIDS. The supply side analysis essentially looked at the demographic profile / characteristics of workforces i.e. age, gender etc., combined with skill structure – to encompass HIV infection risk as well as HIV/AIDS-related company costs (a given level of prevalence in higher-skilled workforces has a greater cost impact). This was used to generate a sectoral HIV risk index. On the demand side, the study looked at market risk, using demand projections from the macroeconomic model. While sectoral HIV infection rates are not directly measured, company surveys are illustrative, e.g. the prevalence rate in two large mining companies was 30%, but in four large financial services institutions it was only 3.4%.

The study concluded that high-risk (high prevalence) sectors were Mining, Government, Manufacturing and Construction, while low risk sectors were Transport, Communications, Business Services, Finance, and Frade (retail & wholesale). It was noted that although industries with high use of skilled workers tend to have lower prevalence rates, the cost of infection is higher, given that skilled workers are more costly to replace and their absence has more impact on production, and vice versa with semi/unskilled. The study produced a ranking of HIV/AIDS risk by sector, based on supply side impacts, as shown below.

The study also models the channels through which HIV/AIDS affects domestic final demand (household and government consumption, investment), exports, and intermediate demand (demand for one industry's output by another industry). Overall, real GDP growth is lower as a result of HIV/AIDS, but the effect is not uniform across the economy. Analysis shows that fixed investment is the component of demand most affected, which feeds through to industries such as construction. While there is no clear pattern of sectors that are affected on the demand side by HIV/AIDS, it is primarily those where investment (rather than consumption) demand is important, and where their output comprises predominantly intermediate demand that is very dependent upon the output of other sectors. Despite the impact of HIV/AIDS on the population, sectors that are mainly dependent upon household consumption (community & social services; food & beverages; clothing, etc.) do not seem to be particularly badly affected.

A study by Rosen *et al* (2004) reviewed the results of research projects on the company level impact of HIV/AIDS. Amongst the conclusions of the survey were that a few variables explain most of the differences in costs among firms. While there was a good deal of variation in costs across and within countries and sectors, there is also some consistency in the drivers of costs, which are mainly HIV prevalence in the workforce population; the job level of affected employees (as morbidity and mortality among more skilled (and higher paid) employees impose higher costs on employers than they do among less skilled employees); the structure of employment (permanent vs contract and casual workers); company ownership; and Industrial sector (mining and manufacturing firms face higher costs than service and agricultural firms, probably as a result of differences in capital intensity, labour productivity, and workforce demographics).

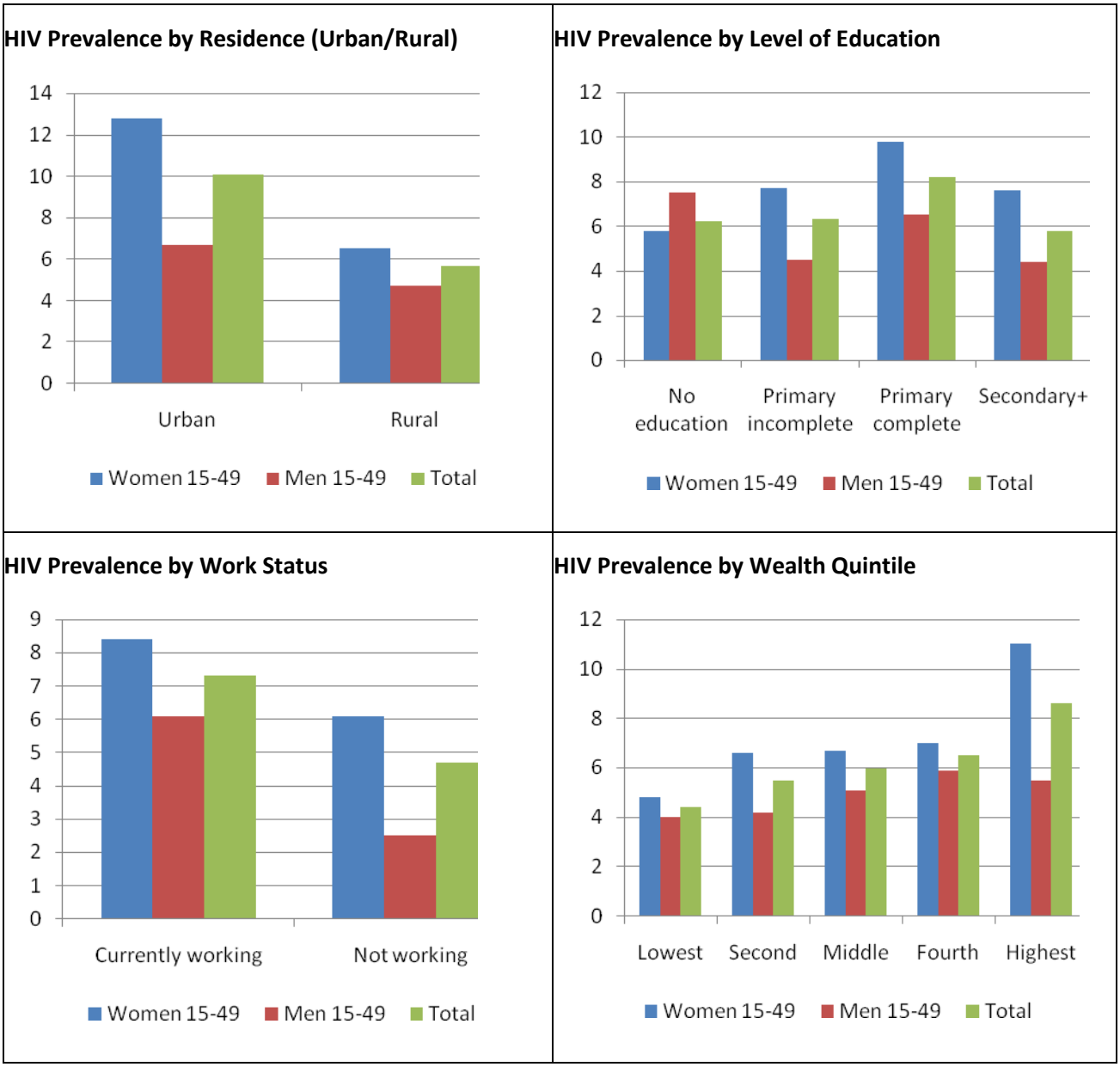
The present study aims to evaluate the sectoral impact of HIV/AIDS in Uganda through the impact on the labour force. It uses existing survey data on the occupation and skill structure of different economic sectors, and the HIV prevalence rate across different sectors and occupations. By sectors, we refer to the classification of economic activities in the UNHS. It should be noted that the impact of HIV/AIDS in Uganda may not necessarily be the same as in South Africa, as there are significant differences in both the economic environment and the HIV/AIDS situation. Compared to South Africa, the Ugandan economy is much more dominated by agriculture (especially subsistence agriculture). Uganda also has a much lower HIV prevalence rate, and whereas in South Africa prevalence rates tend to be inversely-related to skills, education and income (prevalence rates are higher amongst lower skilled, less educated and less well paid workers), in Uganda the opposite is true. In South Africa, the high cost of HIV/AIDS stemming from its impact on highly skilled workers (who are more expensive to replace and train) is partially offset by a lower prevalence rate amongst such workers, leading to a lower impact in sectors with highly skilled workforces (such as financial services). In Uganda, however, this may not be the case.

## 2. Sectoral Impact – HIV Prevalence

The analysis in this chapter is done on the premise that there is no access to ART, and therefore HIV+ people will die as a result of AIDS. The respective sectors of the economy will need to replace them with new employees to make up for lost labour capacity. This would have a negative economic impact, due to the additional costs involved. It is then assumed that the impact of these losses would provide part of the justification for expenditure on ART by government and donors. This is because it is believed that an HIV+ person that is on ART can live longer, remain healthy, and can perform to his full capacity in terms of his/her economic participation of the country.

This study makes use of the results of the 2004/05 Sero-Prevalence Survey which records HIV prevalence across a range of individual and household characteristics. The results show that although the overall adult (15-49 years) prevalence rate was 6.4%, there are considerable variations around this total by gender, location and wealth status (see Figure 10). In summary, urban HIV prevalence is higher than rural; there is some evidence of rising HIV prevalence as education increases; prevalence is higher amongst those working than amongst those not working; there is a clear positive relationship between HIV prevalence and level of wealth; and female prevalence is higher than male prevalence.

**Figure 10: HIV Prevalence by Residence, Education, Work Status and Wealth**

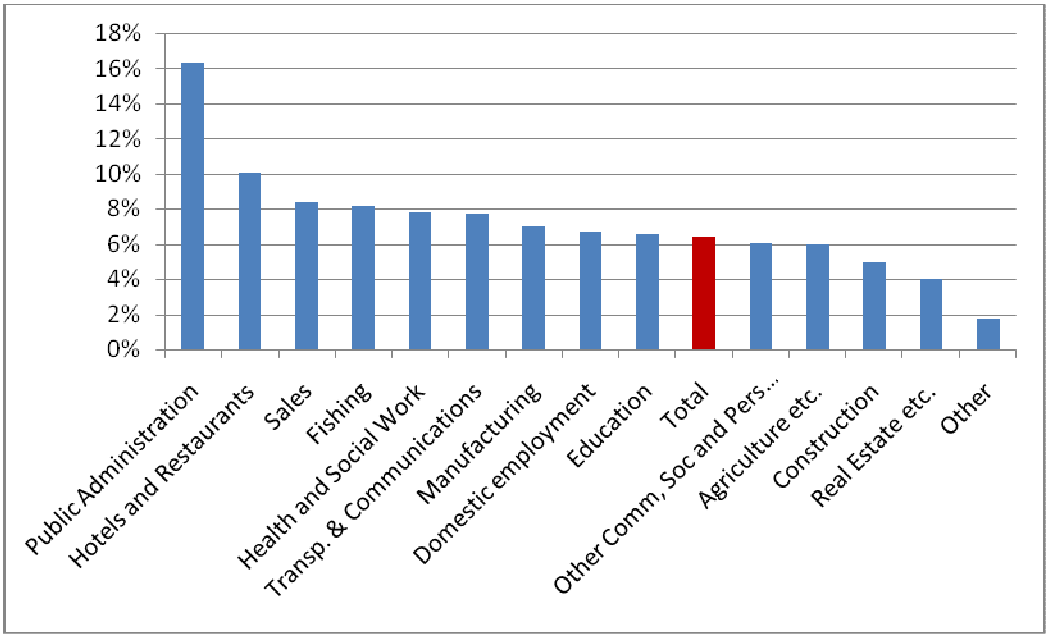



*Source: MoH, 2006 (Sero survey)*

The survey also provides data on sero-prevalence across economic sectors (see Figure 11). This shows major variations in the HIV prevalence rate between sectors. By far the highest is Public

Administration, with a prevalence rate of 16.3%. Agriculture has a relatively low prevalence rate of 6.0%, with prevalence being higher in most non-agricultural sectors of the economy[11].

**Figure 11: HIV Prevalence by Sector**

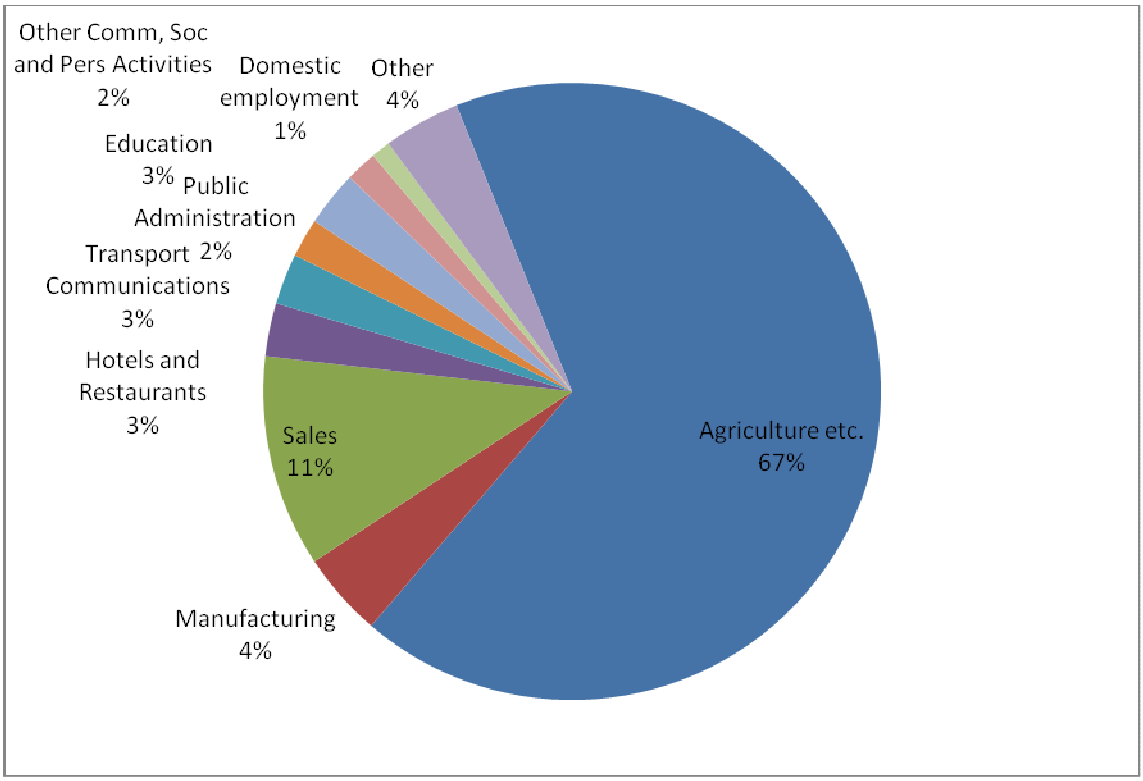



*Source: Calculations based on Sero survey data (MoH, 2006)*

Although the prevalence rate is (relatively) low in the Agricultural sector, it is of course by far the largest sector of the economy. Hence if we consider the estimated numbers of HIV+ workers across the economy, a different picture emerges (Figure 12).

[11] Note that the sample size was very small in mining, financial intermediation, extra-territorial organisations and electricity, gas & water, and these sectors are grouped together as "other".

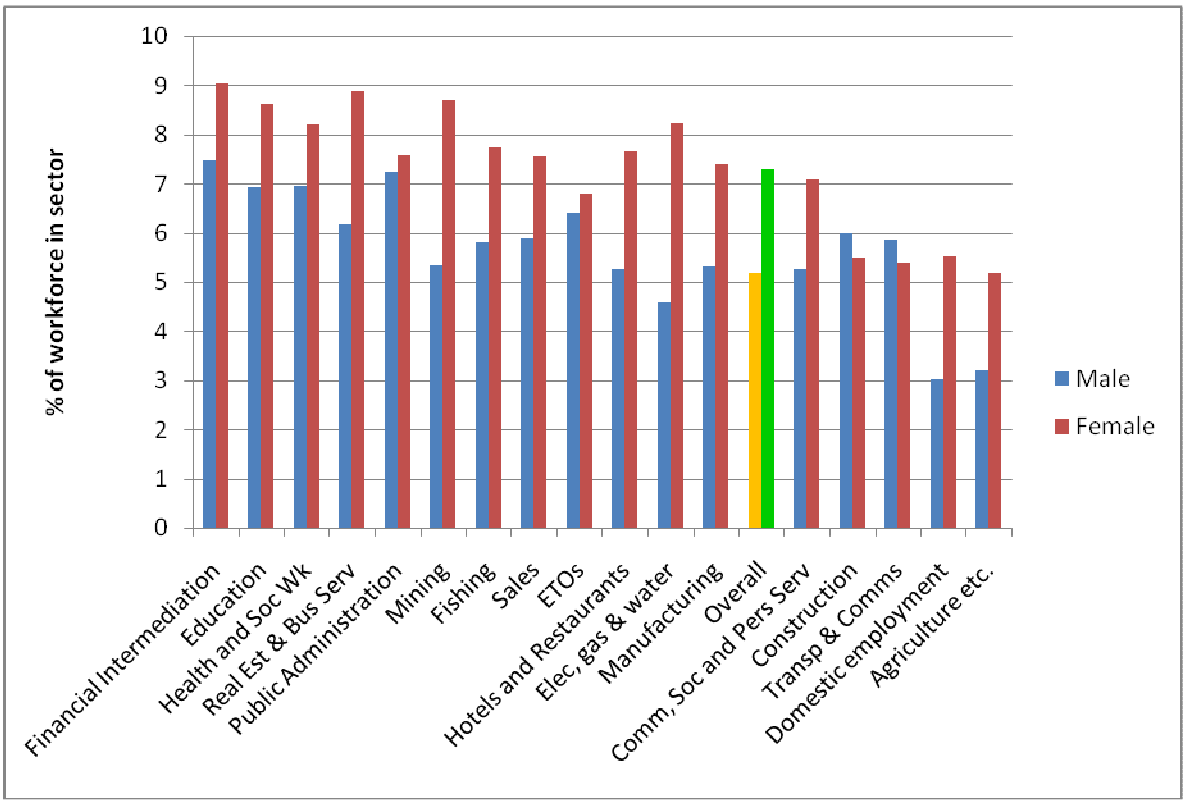
**Figure 12: Distribution of HIV+ Workers by Sector**




*Source: Calculations based on Sero survey data (MoH, 2006)*

Looking at HIV prevalence by sector and by gender, Figure 13 shows that a higher proportion of female employees are likely to be HIV+ than their counterpart male employees. However, there are a few sectors such as Construction, Transport and Communications that show a contrasting picture, with a higher male prevalence rate. In Public Administration, the difference in the male and female prevalence rates is small.

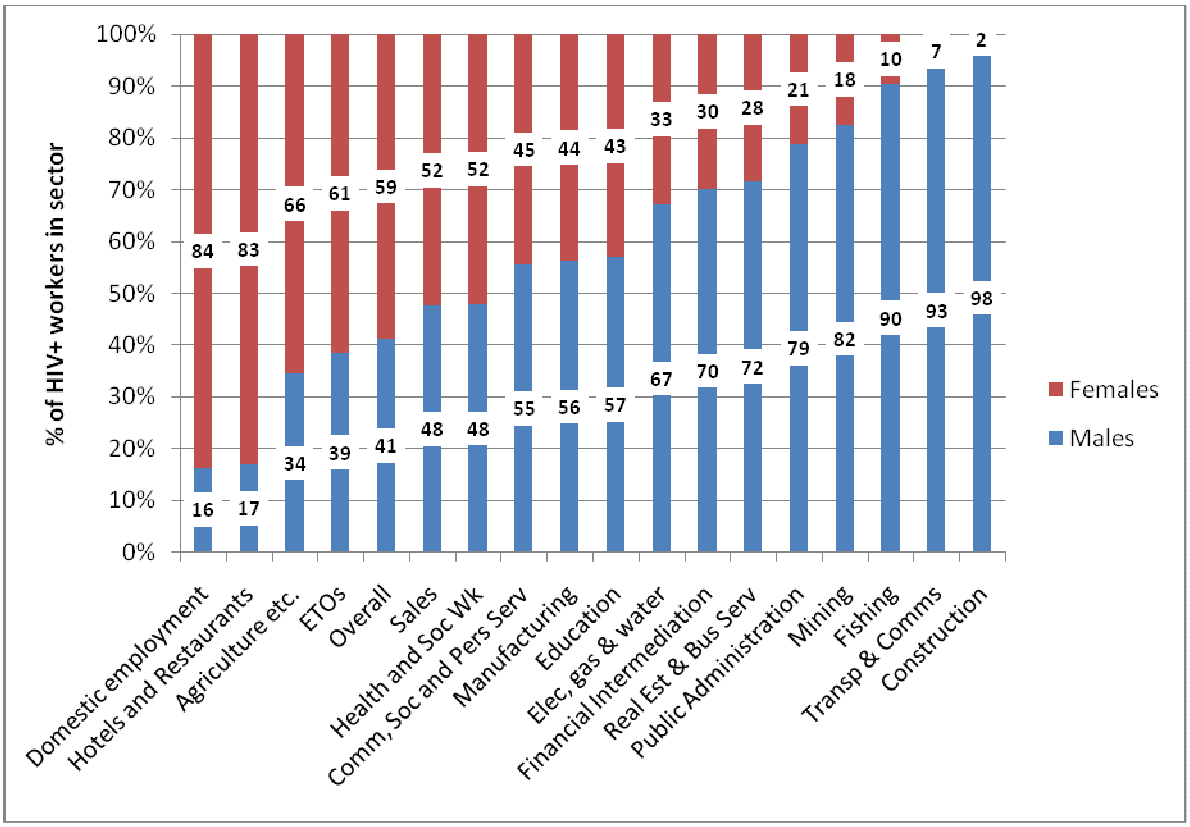
**Figure 13: HIV Prevalence by Gender and Sector**




*Source: Calculations based on Sero survey data (MoH, 2006)*

With regard to the absolute numbers of HIV+ workers in each sector, the picture may differ from that of prevalence rates, since some sectors may be dominated by men and others by women. The distribution of male and female HIV+ workers in each sector is shown in Figure 14. Therefore, in Construction, Transport & Communications, Fishing, Mining and Public Administration, where the workforce comprises predominantly males, the latter account for more than 75% of the HIV+ workforce in each sector. By contrast, in domestic employment and hotels & restaurants, females make up the majority of the workforce, and more than 80% of the HIV+ workers in these sectors. Similarly in agriculture, two-thirds of the HIV+ workers are women.

**Figure 14: Distribution of HIV+ Workers by Sector and Gender**

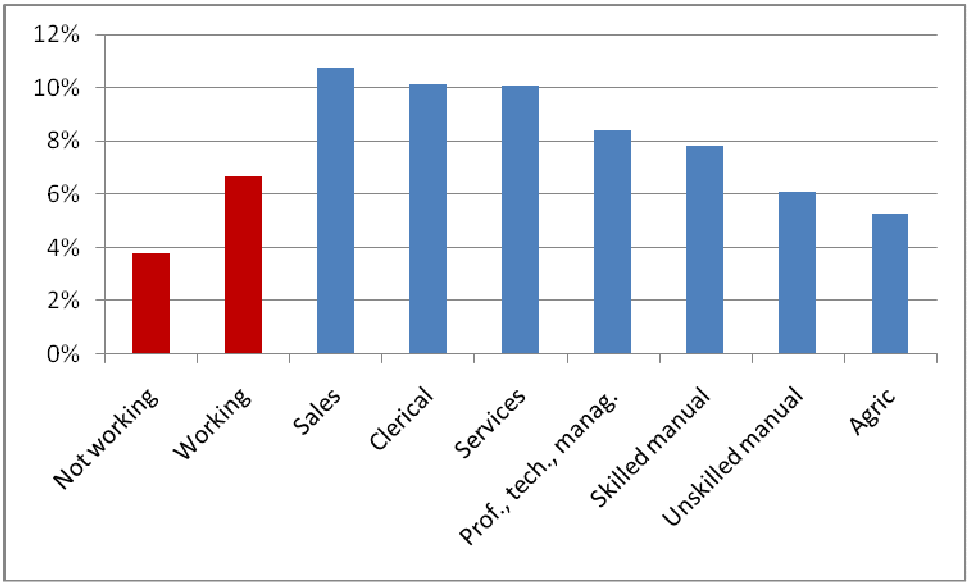



*Source: Calculations based on Sero survey data (MoH, 2006)*

## 3. Sectoral Impact – Occupational Structure

The sero survey also provides information on HIV prevalence by occupation. As noted earlier, there is a higher prevalence rate amongst working adults than non-working adults. Amongst working adults, there is some evidence that HIV prevalence varies across occupations (Figure 15). The prevalence rate is relatively high amongst Sales, Clerical and Service sector workers, who might generally be classed as semi-skilled. There is a slightly lower, but above average, prevalence rate for skilled professional and manual workers. The lowest prevalence rates are for the unskilled categories of manual and agricultural workers. These results confirm that unskilled workers have lower HIV prevalence rates than semi-skilled and skilled workers which is contrary to the findings in South Africa.

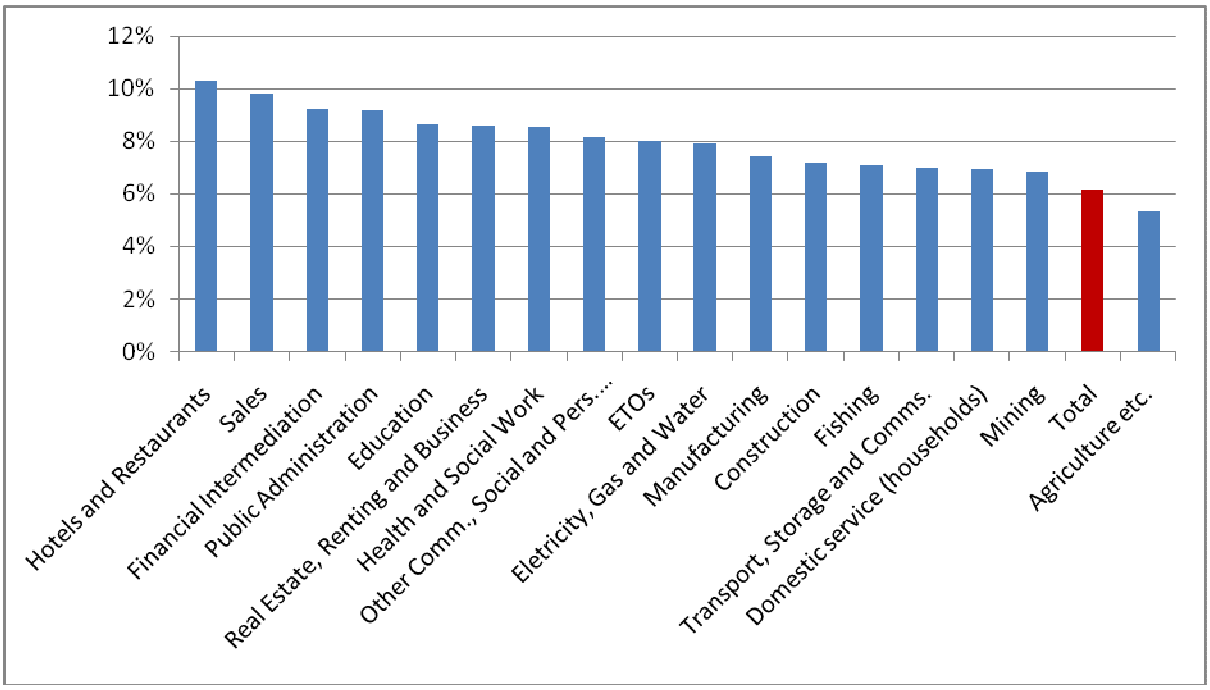
Figure 15: HIV Prevalence by Occupation




*Source: Calculations based on Sero survey data (MoH, 2006)*

The information on HIV prevalence by occupation can be combined with information on the sectoral composition of the labour force in different sectors to further analyse sectoral vulnerabilities. First we can calculate a "proxy" HIV prevalence rate by sector, taking into account these two pieces of information. This is shown in Figure 16 below, and is calculated by combining occupational HIV prevalence rates with the occupational structure of the various sectors. The results are largely consistent with the earlier results (in Figure 11), although the prominence of Public Administration is reduced. We also have a proxy prevalence rate for financial intermediation, which suggests that it is one of the most vulnerable sectors.

**Figure 16: "Proxy" HIV Prevalence Rates by Sector (derived from occupations)**




*Source: Calculations based on Sero survey data (MoH, 2006)*

The above data take account only of the occupational composition of different sectors and occupational prevalence rates. We can also incorporate the varying importance of different labour occupations to the output of each sector, i.e., reflecting the fact that a skilled worker makes a greater contribution to output than an unskilled worker, and is more difficult to replace. Hence, losing a skilled worker is likely to be more disruptive to production than losing an unskilled worker. While the direct contribution of different labour categories cannot be directly measured, we can approximate this from the relative wage rates, which are available from the 2005/06 UNHS.

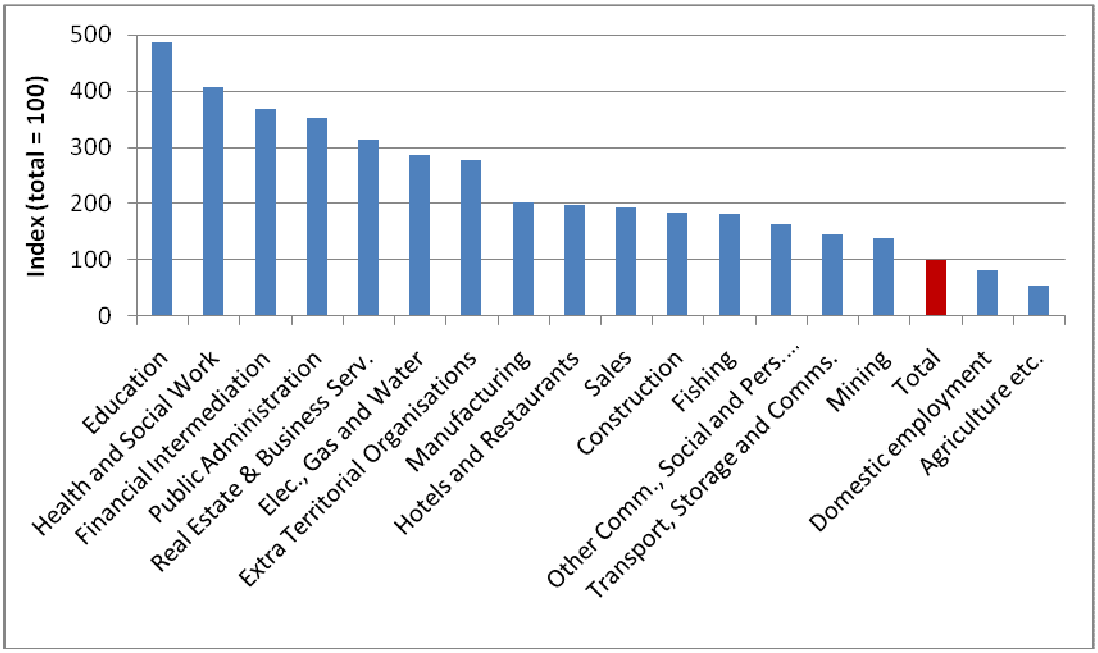
**Table 12: Median Monthly Wages by Occupation**

| Occupation | Monthly wages (Shs '000, median) | Differential (relative to unskilled elementary occupations) |
|---|---|---|
| Legislators, Managers | 120 | 5.0 |
| Professionals | 250 | 10.4 |
| Technicians & Associate Professionals | 148 | 6.2 |
| Clerks | 80 | 3.3 |
| Sales & Service | 50 | 2.1 |
| Agriculture & Fisheries | 27 | 1.1 |
| Crafts & related Trades | 91 | 3.8 |
| Plant & Machine Operators | 91 | 3.8 |
| Elementary Occupations | 24 | 1.0 |

*Source: UNHS 2005/06, Table 4.8 & own calculations*

Taking this into account, the relative sectoral vulnerabilities are shown in Figure 17. These primarily reflect each sector's dependence on skilled labour, as well as the variations in HIV prevalence across occupational categories. The most vulnerable sectors are Education, Health and Social Work, Finance as well as Public Administration, because of their high dependence upon skilled workers.

**Figure 17: Index of Sectoral Vulnerability**




*Source: Own calculations*

An alternative approach to evaluating sectoral vulnerability is to consider the cost of educating and training workers at different levels. To the extent that HIV+ workers will die in the absence of treatment and would have to be replaced, then the cost of educating and training these workers represents a burden on the economy.

Information on the level of education of workers in different sectors is available from the 2006 Labour Market Conditions Report. The overall composition of the labour force by education level is shown in Table 13.

### Table 13: Education Level by Sector (% of workforce in sector)

| | No formal educ. | Some primary | Comple-ted P7 | Some secondary | Comple-ted S6 | Post secondary | Do not know |
|---|---|---|---|---|---|---|---|
| **Agriculture etc.** | 17.5% | 51.4% | 13.6% | 16.3% | 0.6% | 0.5% | 0.1% |
| **Fishing** | 13.8% | 48.6% | 17.4% | 17.4% | 0.9% | 1.8% | 0.0% |
| **Mining** | 4.5% | 40.9% | 27.3% | 18.2% | 4.5% | 0.0% | 4.5% |
| **Manufacturing** | 10.0% | 40.4% | 17.0% | 25.8% | 2.0% | 4.6% | 0.2% |
| **Electricity, Gas and Water** | 0.0% | 30.0% | 0.0% | 20.0% | 20.0% | 30.0% | 0.0% |
| **Construction** | 5.0% | 30.8% | 21.4% | 33.8% | 2.0% | 7.0% | 0.0% |
| **Sales** | 8.6% | 37.9% | 18.4% | 28.7% | 1.9% | 4.4% | 0.1% |
| **Hotels and Restaurants** | 15.1% | 36.2% | 17.9% | 25.2% | 0.5% | 4.6% | 0.5% |
| **Transport, Storage and Comms.** | 1.8% | 36.0% | 21.3% | 36.4% | 1.1% | 2.9% | 0.4% |
| **Financial Intermediation** | 0.0% | 0.0% | 0.0% | 17.6% | 11.8% | 70.6% | 0.0% |
| **Real Estate, Renting and Business** | 0.0% | 16.0% | 4.0% | 54.0% | 8.0% | 18.0% | 0.0% |
| **Public Administration** | 1.0% | 15.3% | 8.2% | 35.7% | 8.2% | 31.6% | 0.0% |
| **Education** | 1.1% | 2.6% | 2.3% | 46.0% | 4.3% | 43.7% | 0.0% |
| **Health and Social Work** | 3.5% | 9.2% | 8.5% | 44.0% | 1.4% | 33.3% | 0.0% |
| **Other Community, Social and Pers. Activities** | 8.8% | 34.0% | 14.4% | 32.6% | 4.7% | 5.1% | 0.5% |
| **Domestic Service** | 19.5% | 50.0% | 15.3% | 14.4% | 0.0% | 0.0% | 0.8% |
| **Extra Territorial Organisations** | 0.0% | 22.2% | 0.0% | 55.6% | 11.1% | 11.1% | 0.0% |
| **Total** | **14.7%** | **46.1%** | **14.1%** | **20.4%** | **1.1%** | **3.4%** | **0.1%** |

*Source: Calculations based on UNHS data (UBOS, 2007)*

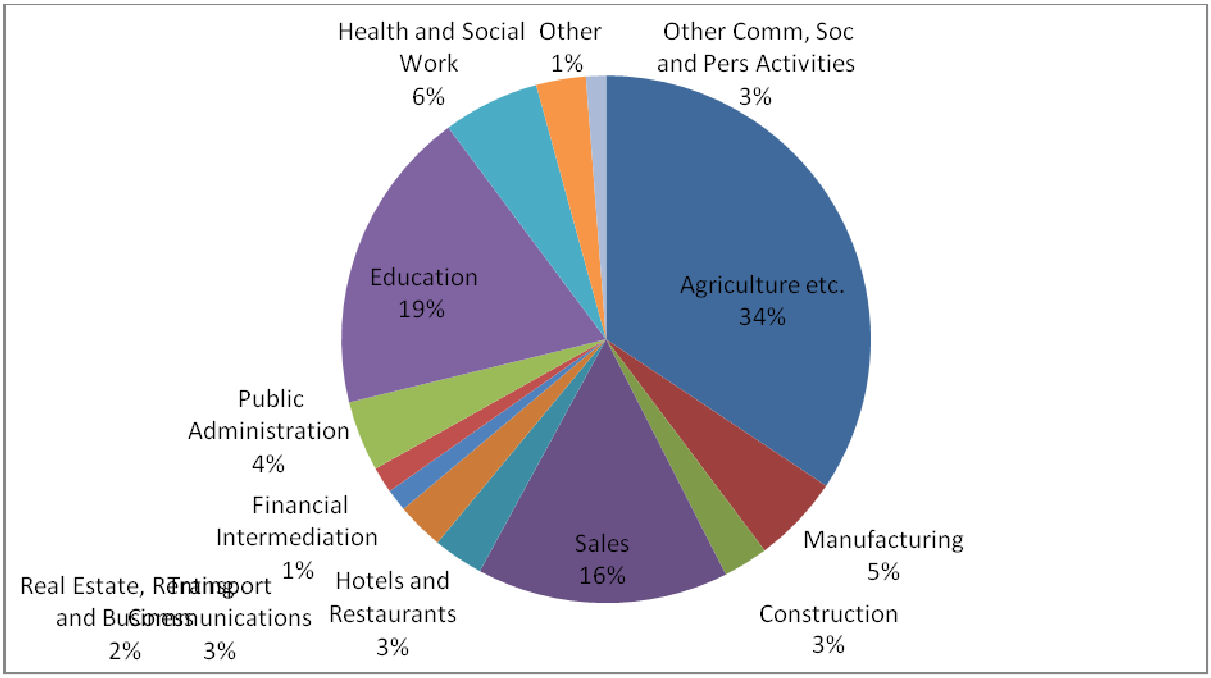
This information can be combined with estimates of the cost of educating students to different levels, as shown in Table 14.

### Table 14: Cost of Education

| Level | Cost per term/semester (Shs) | Total cost to this level (Shs) |
|---|---|---|
| **No formal education** | 0 | 0 |
| **Primary years 1-4** | 20 000 | 240 000 |
| **Primary years 5-7** | 50 000 | 690 000 |
| **Secondary years 1-4** | 150 000 | 2 490 000 |
| **Secondary years 5-6** | 200 000 | 3 690 000 |
| **Post secondary** | 1 200 000 | 10 890 000 |

This information can be used to calculate the total cost of educating workers in the sector who may die due to HIV/AIDS (see Figure 18). The cost depends on the size of the sector (number of workers), the level of education of workers in the sector, and the sectoral HIV prevalence rate. While agriculture faces the biggest cost (34% of the total cost), it is proportionately much less than its share of employment (74%), because of the relatively low level of education of workers in the sector. The education sector faces a relatively high cost (16%) relative to its employment share (3%), due to its high dependence upon educated workers.

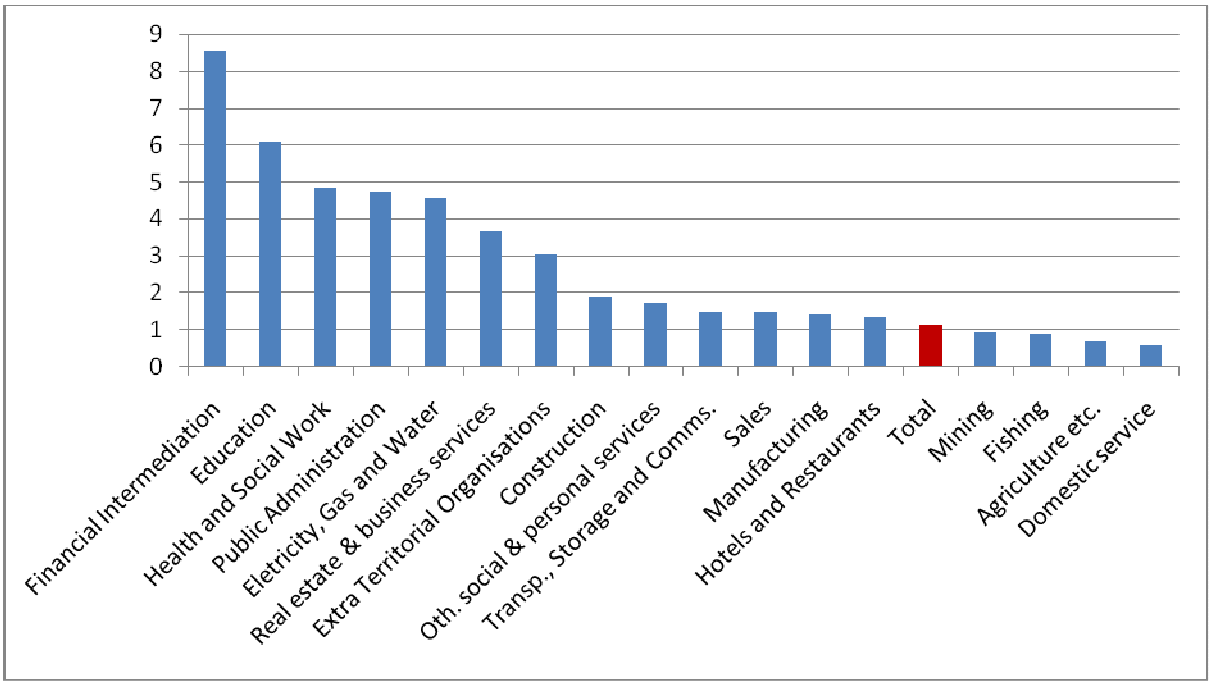
**Figure 18: Total Cost of Educating HIV+ Workers (% by sector)**




*Source: Own calculations*

A more accurate assessment of the cost burden can be obtained by considering the average cost of educating a worker in the sector (see Figure 19).

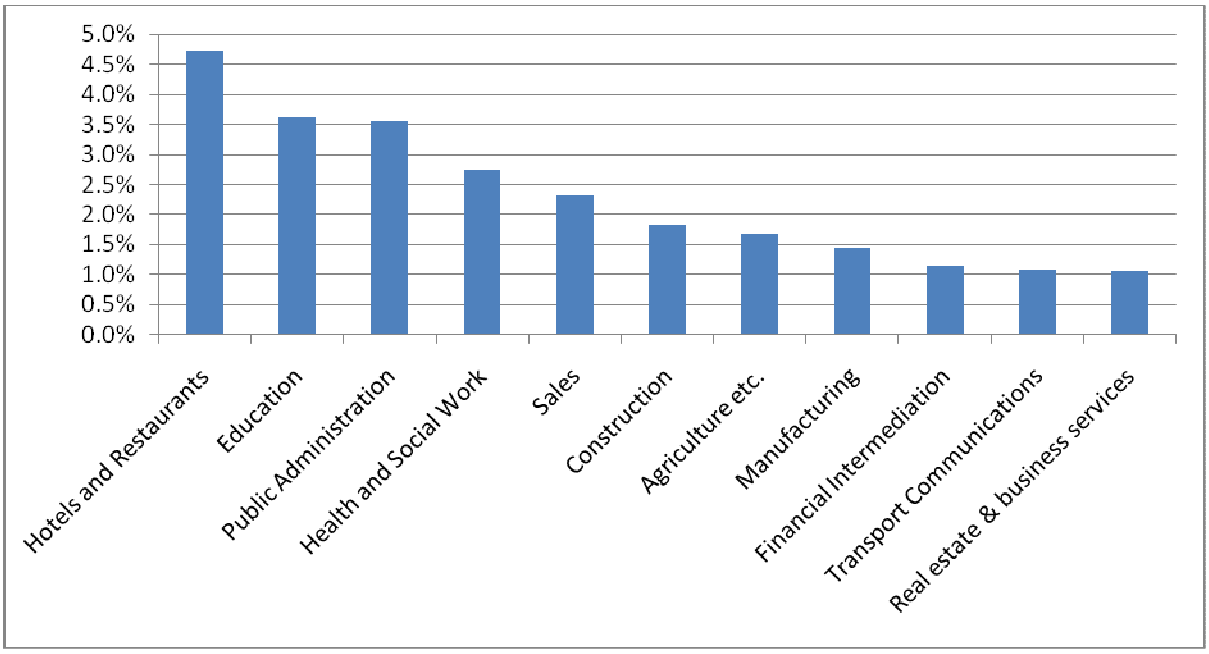
**Figure 19: Cost of Education of an Average Worker, by Sector (Shs million)**




*Source: Own calculations*

This cost can be further related to the wage bill in the sector, i.e., the cost of replacing HIV+ workers as a proportion of the annual wage bill. On the assumption that HIV+ workers live on average ten years after getting infected, the burden is shown in Figure 20. The greatest burden is in the Hotels & Restaurants sector, which mainly represents the impact of relatively low wages in the sector combined with a high HIV prevalence rate. The next highest burdens are in Education, Public Administration and Health & Social Work, reflecting the high level of education of workers in these sectors and relatively high prevalence rates. While the Financial Services sector has both a relatively high prevalence rate and highly educated workers, it also has the highest wage levels of any sector so the relative cost of educating workers is reduced.

**Figure 20: Cost of Replacing HIV+ Workers (as % of annual wage bill)**



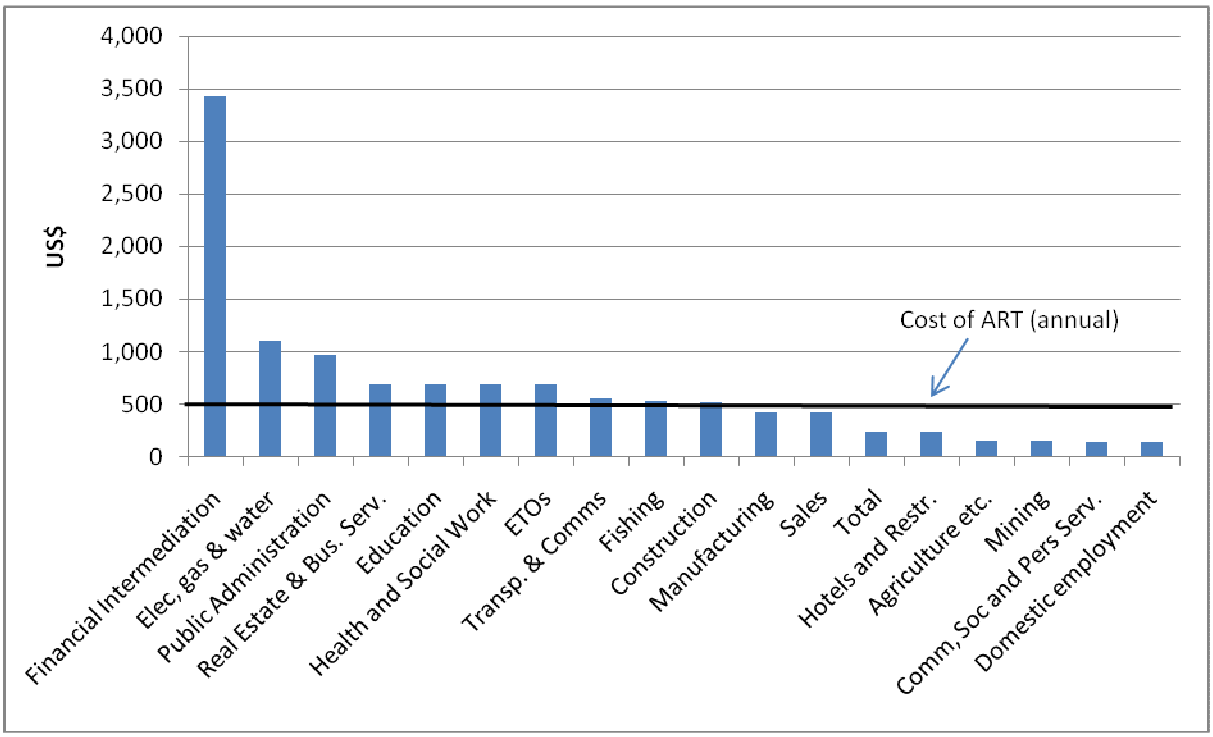

*Source: Own calculations*

## 4. Cost of Providing Anti-Retroviral Therapy (ART)

Using the above information, we can compare the cost of education of workers in different sectors with the cost of providing ART. Education costs across sectors are shown in Figure 19 above, and varies from Shs 590 000 in domestic service to Shs 8 561 000 in financial intermediation. In terms of the USA dollar, the cost of education varies from approximately US$ 350 to US$ 5 000. This compares with the cost of providing ART, which is around US$ 500 a year per person. If we assume that the average (median) additional life-years resulting from ART is ten, then the total cost of providing ART to an HIV+ person is US$ 5000. In straightforward financial terms, therefore, ART is not a good investment when compared to the cost of educating workers, as the cost of the lost education is less than the cost of providing ART in all sectors except for the Finance sector. While the total cost of providing trained, experienced and educated workers is greater than the cost of education used here (the study is limited by lack of information on the costs of on-the-job training and the value of experience), this example nevertheless illustrates that ART may not be a good investment in purely financial terms, at least not for all workers.

An alternative perspective on this issue can be gained by considering the cost of ART relative to wage costs; if we assume that the value of a worker's contribution to output is approximately equal to the wage he or she receives, then this provides a crude comparison of the costs of ART with the value of output provided by a worker who continues to contribute to produce. Wage costs by sector are shown in Figure 21. Only in a few sectors (Financial Services; Electricity, Gas & Water; as well as Public Administration) are average wages significantly above the annual US$ 500 cost of ART, although in several other sectors, average wages are just above US$ 500. This again suggests that the cost of providing ART may not be justified in financial terms in many sectors of the economy.

**Figure 21: Average Wage by Sector (US$/year)**




*Source: Own calculations*

## 5. Summary and Conclusion

This study presents an analysis of the impact of HIV/AIDS on different economic sectors, measured by the impact on the labour force in each sector. This impact was assessed primarily through the level of education of workers in each sector, and the cost of educating replacement workers to make up for those who die as a result of HIV/AIDS. These costs therefore depend on the level of education of workers in each sector, and differences in HIV prevalence by level of education and across sectors.

The study does have some limitations. First, the costs relate specifically to educating workers at different levels and do not take account of the loss of experience gained while working. Therefore the costs of replacing workers in the Agricultural sector may be under-estimated, given that they generally have low levels of education but significant skills acquired through experience. The second limitation is that the costs of recruitment and on-the-job training could not be quantified and are therefore omitted from the analysis. This could lead to an under-estimate of the cost of replacing people that die of HIV/AIDS, especially in sectors such as Financial Services and Public Administration where there are high levels of job-specific training, and potentially lengthy recruitment processes, especially for senior staff.

Subject to these limitations, the overall results of the sector vulnerability analysis can be summarised as follows:

- The HIV prevalence rate (measured directly) is highest in Public Administration, followed by Hotels & Restaurants, Sales, and Fishing. When measured indirectly, the prevalence rate is highest in Hotels & Restaurants, followed by Sales, Finance and Public Administration.
- The total number of HIV+ workers is highest in Agriculture, followed by Sales.

- The cost of educating a worker is highest in Financial Intermediation (at P8.6 million Shs), followed by Education (at Shs 6.1 million), Health (at Shs 4.9 million) and Public Administration (at Shs 4.7 million).
- The total cost of replacing HIV+ workers (through the investment needed in their education) is highest in Agriculture (34% of the total), followed by Education (19%) and Sales (16%).
- The cost burden of replacing an HIV+ worker, as a proportion of the wage bill, is highest in Hotels & Restaurants, Education and Public Administration.
- Relative to the costs of educating workers, or average wages (as an approximation of the value of output produced), providing ART may not be a good investment in purely financial terms.

# 6. Appendix: Data Tables

| Sector | HIV prev rate (proxy) | Total labour force (2002 Census & Labour Mkt survey) | Av wage (UGX/month) | Total Wage Bill (UGX million/month) | No. HIV+ | Total Education cost and training to replace those dying due to AIDS | Cost per HIV+ worker that may die | Cost per worker (all workers) | Total cost as % of annual wage bill | Annual cost as % of annual wage bill |
|---|---|---|---|---|---|---|---|---|---|---|
| Agriculture, etc. | 5.3% | 7,828,900 | 22,000 | 172,236 | 409,037 | 286,625 | 700,730 | 36,611 | 14% | 1.4% |
| Fishing | 7.1% | 105,560 | 77,000 | 8,128 | 6,661 | 6,026 | 904,679 | 57,088 | 6% | 0.6% |
| Mining | 6.8% | 14,849 | 22,000 | 327 | 1,295 | 1,215 | 938,182 | 81,841 | 31% | 3.1% |
| Manufacturing | 7.4% | 442,895 | 60,000 | 26,574 | 32,076 | 45,959 | 1,432,800 | 103,769 | 14% | 1.4% |
| Elec, Gas & Water | 7.9% | 7,296 | 160,000 | 1,167 | 683 | 3,127 | 4,575,000 | 428,564 | 22% | 2.2% |
| Construction | 7.1% | 147,342 | 75,000 | 11,051 | 12,395 | 23,500 | 1,895,970 | 159,496 | 18% | 1.8% |
| Sales | 9.8% | 869,193 | 60,000 | 52,152 | 88,537 | 131,318 | 1,483,206 | 151,080 | 21% | 2.1% |
| Hotels and Restaurants | 10.3% | 170,137 | 33,000 | 5,615 | 19,345 | 26,275 | 1,358,257 | 154,433 | 39% | 3.9% |
| Transport Communications | 7.0% | 210,103 | 80,000 | 16,808 | 16,358 | 24,594 | 1,503,419 | 117,055 | 12% | 1.2% |
| Financial Intermediation | 9.2% | 16,818 | 500,000 | 8,409 | 1,352 | 11,576 | 8,560,588 | 688,296 | 11% | 1.1% |
| Real Estate, Renting and Business | 8.6% | 46,369 | 100,000 | 4,637 | 3,702 | 13,573 | 3,666,000 | 292,720 | 24% | 2.4% |
| Public Administration | 9.2% | 71,582 | 140,000 | 10,021 | 7,761 | 36,697 | ,728,367 | 512,650 | 31% | 3.1% |
| Education | 8.6% | 281,303 | 100,000 | 28,130 | 26,106 | 158,883 | 6,085,971 | 564,811 | 47% | 4.7% |
| Health and Social Work | 8.5% | 102,073 | 100,000 | 10,207 | 10,366 | 50,359 | 4,858,085 | 493,362 | 41% | 4.1% |
| Other Comm, Soc and Pers Activities | 8.1% | 179,172 | 20,000 | 3,583 | 15,070 | 25,976 | 1,723,674 | 144,979 | 60% | 6.0% |
| Domestic employment | 6.9% | 91,352 | 20,000 | 1,827 | 7,038 | 4,151 | 589,831 | 45,440 | 19% | 1.9% |
| ETOs | 8.0% | 4,042 | 100,000 | 404 | 622 | 1,900 | 3,056,667 | 470,002 | 39% | 3.9% |
| **Total** | **6.2%** | **10,588,986** | | **361,276** | **653,472** | **736,222** | **1,126,630** | | **17%** | **1.7%** |

# Chapter 4: HIV Costing, Financing and Expenditure

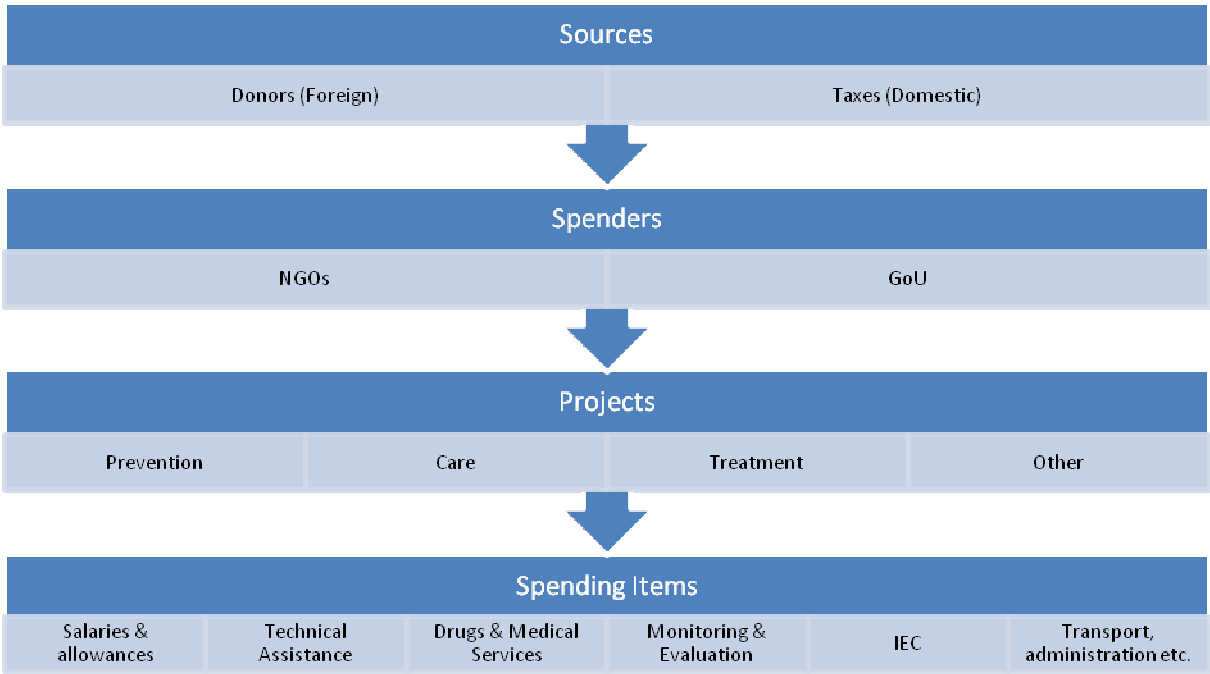
## 1. Introduction

One of the major determinants of the macroeconomic impact of HIV/AIDS expenditure is the extent to which that spending is sourced domestically (from the Government budget) or externally (from donor funds). A second important aspect is whether the funds are spent externally (on, for instance imported drugs) or domestically (e.g., local salaries or purchase of locally-produced inputs). Most of the concerns about the impact of HIV/AIDS on expenditure stems from concerns that large amounts of external funds flowing into the country boost aggregate demand, which in turn causes inflation and real exchange rate appreciation (and loss of international competitiveness), and destabilise the macroeconomic achievements that have been secured over the past 15 years. However, this effect is reduced when the greater proportion of spending is devoted to imported goods and services, as domestic aggregate demand is less affected.

While there is some information on the sourcing of HIV/AIDS funding, there is little or no information on how the money is spent, or what it is spent on. The objective of this assignment is to track the flow of resources received through to spending, to determine what HIV/AIDS-related funds are spent on, and in particular, whether that expenditure is on domestic or imported goods and services.

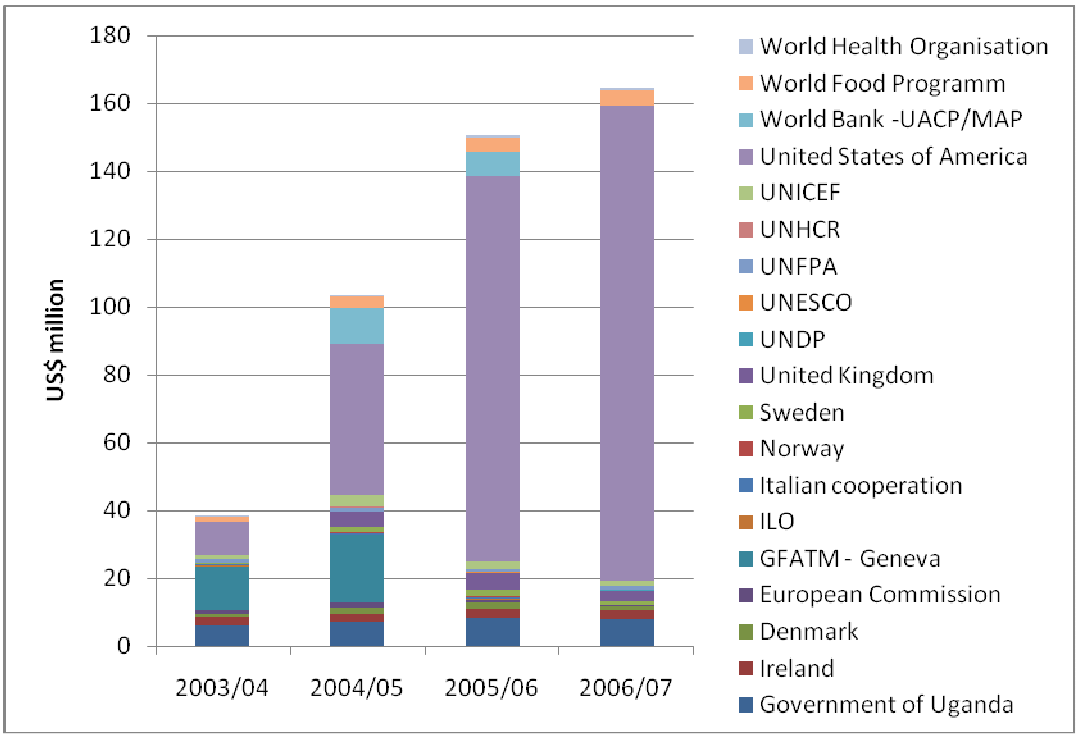
The overall flow of funding for HIV/AIDS-related activities is depicted in Figure 22, at four levels: (i) Sources of finance; (ii) Spending agencies; (iii) Projects; and (iv) Spending items.

**Figure 22: HIV/AIDS Funding and Expenditure**



High level data on overall HIV/AIDS spending and financing from 2003/04 to 2006/07 were collected by Lake & Mwijuka (2006) (see Figure 23). This focused on overall spending levels and sources of financing, and illustrated the rapid increase in overall spending on HIV/AIDS programmes over this period, rising from US$ 38 million to US$ 164 million in four years. As the chart illustrates, this was largely driven by greatly increased funding from the USA. Almost all spending was financed externally – domestic funding from the GoU increased from US$ 6 million to US$ 8 million over this period, but at the same time the GoU's share of total spending fell from 16% to 5%.

**Figure 23: Financing of HIV/AIDS-related Spending, 2003/4 - 2006/7**




*Source: Lake & Mwijuka (2006)*

## 2. Methodology

The focus of this study is not on overall funding levels but on providing more detail on spending. The methodology followed has been to gather information from resource providers (donors and the GoU) relating to the sources of funds, and from entities involved in spending those resources. Information has been sought on the main categories of expenditure, and on whether that expenditure was mainly domestic or external. The emphasis has been on tracking the main financial flows, rather than all financial flows. Owing to the nature of the exercise, this information seems incomplete, but the objective is to isolate the main flows in order to ascertain the macroeconomic magnitudes.

The categories of spending identified were:

- Salaries
- Allowances
- Technical Assistance
- Drugs & Medical Services
- Information, Education and Communication (IEC)
- Monitoring & Evaluation (M&E)

- Training
- Transport/vehicles
- Miscellaneous Supplies
- Other

An instrument was developed to collect the necessary data from donors and implementing agents, and results were obtained from a range of financing and implementing agencies (see Appendix). Information was requested for the years 2004/05, 2005/06 and 2006/07. Spending entities were identified by the President's Emergency Plan for AIDS Relief (PEPFAR) list of Prime Partners (see Appendix) and other sources. PEPFAR is by far the dominant funder of HIV/AIDS-related activities in Uganda, with budgeted spending increasing from US$ 135 million in FY2005 to US$ 236 million in FY2007.

# 3. Results

Unfortunately, it was not possible to get the data in as consistent a form as desirable, due to variations in the quality of information across agencies. In particular, many agencies did not keep information in a form which enables the disaggregation of spending into the categories required by the project, especially with regard to domestic versus external spending, while others were unwilling to provide such information even where it existed.

In the public sector, expenditure on HIV/AIDS was not well distinguished from expenditure on other health activities. For instance, expenditure on blood transfusion services to ensure provision of safe blood to patients includes expenditure on ensuring that blood is free from HIV but also free from hepatitis B, malaria, syphilis, etc. It is therefore difficult to know what proportion of the money is spent on HIV at blood transfusion services. The same situation applies to other goods and services e.g. human resources, vehicles, infrastructure, etc.

Information on HIV/AIDS-related spending over the period 2004/05 to 2006/07 was obtained from the following institutions (see Table 15), covering two-thirds (estimated at 67%) of total spending over the relevant period.

### Table 15: HIV/AIDS-related Spending by Institution, 2004/05 – 2006/07 (US$)

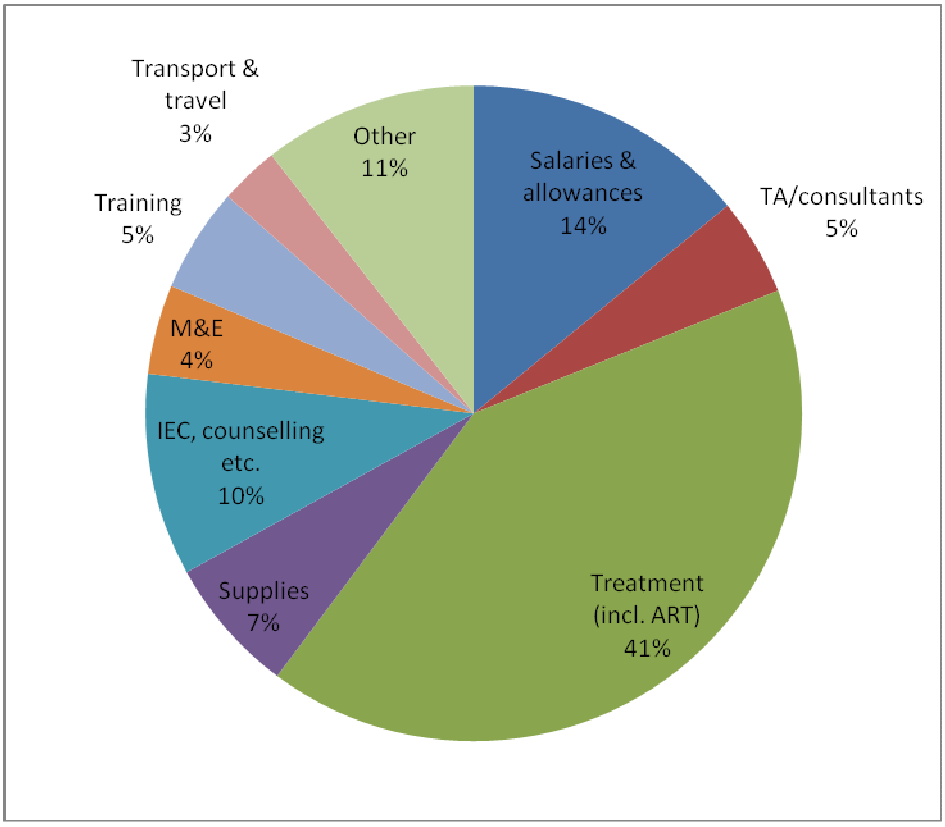
| Institution | 2004/5 | 2005/6 | 2006/7 | Total |
|---|---|---|---|---|
| Christian Children's Fund (CCF) | 421,882 | 614,878 | 528,515 | 1,565,275 |
| AVSI | 226,197 | 677,378 | 955,790 | 1,859,365 |
| Elisabeth Glaser Pediatric AIDS Foundation | 2,100,000 | 3,125,000 | 4,220,000 | 9,445,000 |
| Protecting Families Against HIV/AIDS (PREFA) | | 1,299,584 | 1,532,477 | 2,832,061 |
| Uganda Blood Transfusion Service (UBTS) | 1,715,659 | 2,660,689 | 4,010,411 | 8,386,760 |
| Population Services International (PSI) | 3,275,511 | 2,812,718 | 3,635,755 | 9,723,985 |
| International HIV/AIDS Alliance | | | 709,877 | 709,877 |
| The AIDS Support Organisation (TASO) | 10,901,546 | 16,598,357 | 18,870,191 | 46,370,095 |
| Global Fund Against AIDS, Tuberculosis and Malaria (GFATM) | 10,951,458 | | | 10,951,458 |
| Mildmay | | 3,804,083 | 6,095,423 | 9,899,506 |
| Uganda AIDS Commission | 17,391,831 | 12,653,389 | 9,515,461 | 39,560,681 |
| Uganda Virus Research Institute | 241,554 | 170,000 | 144,809 | 556,363 |
| MoH (ACP/STD project) | - | 653,700 | 248,373 | 902,073 |
| International Youth Federation | - | 321,845 | 248,690 | 570,535 |
| National Medical Stores | 11,408,150 | 33,306,262 | 12,410,028 | 57,124,440 |
| Joint Clinical Research Centre | 6,430,580 | 8,495,586 | 11,510,289 | 26,436,454 |
| Catholic Youth Services | - | - | 13,422,117 | 13,422,117 |
| Baylor University | - | - | 1,942,568 | 1,942,568 |
| Mulago-Mbarara | - | 4,789,523 | 5,824,528 | 10,614,051 |
| Plan | 1,070,426 | 2,471,079 | 1,828,093 | 5,369,598 |
| Care | 3,475,745 | 8,442,481 | 10,649,241 | 22,567,467 |
| **Total** | **69,610,540** | **102,896,552** | **108,302,637** | **280,809,729** |
| Estimated total expenditure, 2004/5 - 2006/7 | 103,331,410 | 150,542,306 | 164,396,347 | 418,270,063 |
| Proportion covered | 67.4% | 68.4% | 65.9% | 67.1% |

*Source: Own calculations from study data*

The composition of this spending is shown in

Figure 24.

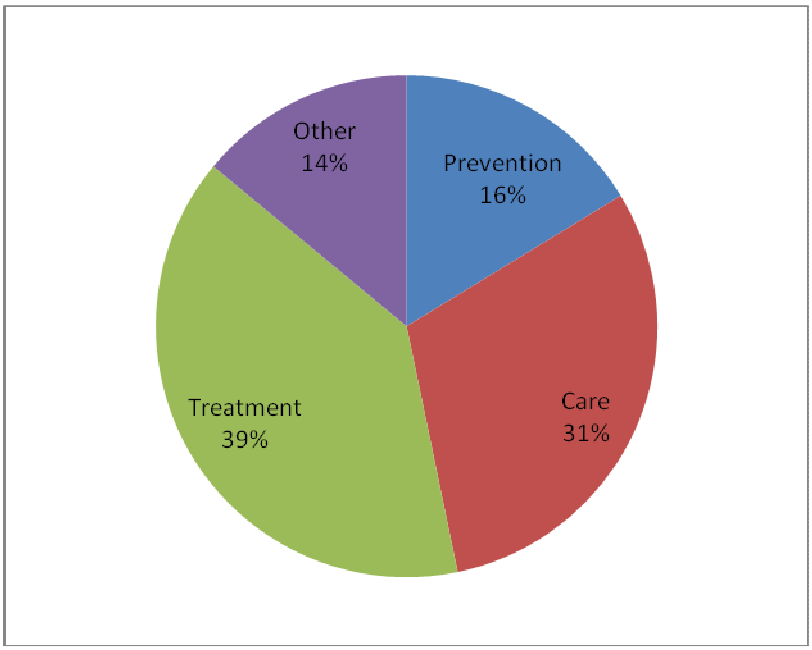
Figure 24: Breakdown of HIV/AIDS Spending 2004/5 - 2006/7




*Source: Own calculations from study data*

Separate, but less detailed data have been obtained regarding PEPFAR funds, which are by far the largest source of funding for HIV/AIDS-related spending. The breakdown of PEPFAR spending over the period 2005/07 is shown in Figure 25.

**Figure 25: Breakdown of PEPFAR Spending, 2005-7**




*Source: Own calculations from PEPFAR data*

The quality of information regarding the breakdown of expenditure between domestic and external spending has not been up to expectation. However, applying estimated proportions of external spending to the various categories of expenditure (ranging from 95% of treatment costs, which are primarily imported drugs, to 10% for information, education and communication (IEC) and training, which are mostly carried out by local staff), enables an estimate of the external spending. As a result, it is estimated that almost 60% of total spending goes (directly or indirectly) on external goods and services, while 40% is spent domestically. The high proportion of donor receipts spent externally significantly reduces the potential macroeconomic impact of aid inflows[12].

**Table 16: External Component of HIV/AIDS-related Spending (2004/5 – 2006/7, US$)**

| Category | | External | |
|---|---|---|---|
| Salaries & Allowances | 39,083,272 | 33% | 13,027,757 |
| TA/Consultants | 13,392,253 | 50% | 6,696,127 |
| Treatment (incl. ART) | 114,963,905 | 95% | 109,215,710 |
| Supplies | 18,658,002 | 67% | 12,438,668 |
| IEC, Counselling, etc. | 27,869,863 | 10% | 2,786,986 |
| M&E | 12,242,485 | 10% | 1,224,248 |
| Training | 14,328,063 | 10% | 1,432,806 |
| Vehicles, Transport & Travel | 8,097,254 | 50% | 4,048,627 |
| Other | 29,381,760 | 33% | 9,793,920 |
| **Total** | **278,016,857** | **58%** | **160,664,850** |

*Source: Own calculations from study data*

Carrying out a similar process for PEPFAR funds yields a similar total (56% external spending).

[12] These estimates include both the direct and indirect external spending components.

**Table 17: External Component of PEPFAR Spending (FY2005-2007, US$)**

| | Amount | External % | External Amount |
|---|---|---|---|
| Prevention | 85 214 972 | 25% | 21 303 743 |
| Care | 159 597 138 | 25% | 39 899 285 |
| Treatment | 205 697 121 | 95% | 195 412 265 |
| Other | 73 225 946 | 50% | 36 612 973 |
| **Total Funding** | **523 735 177** | **56%** | **293 228 265** |

*Source: Own calculations from PEPFAR data*

# 4. Future Resource Needs and Funding

Estimates of future resource needs for HIV/AIDS programmes are provided in the UAC's NSP for 2007/08 to 2011/12. Based on the "high funding" scenario, projected spending will approximately triple from US$ 170 million in 2006/07 to US$ 511 million in 2011/12[13].

The NSP projections envisage that 85% of the funding would come from donors and 15% from the GoU. This represents an increase in the GoU's share from 5% in 2006/07. In view of the anticipated increased share of total spending to be met by the GoU, and the increase in total spending, these projections entail an increase in GoU funding from US$ 8.2 million in 2006/07 to US$ 75 million in 2011/12, a nine-fold increase. Donor funding would increase from US$ 162 million to US$ 436 million over the same period, nearly a three-fold increase. While the anticipated increased GoU funding represents a sharp rise in the proportion of domestic revenues devoted to HIV/AIDS, it should still be sustainable[14]. However, if donor funds were not available, then it is unlikely that the same level of programmes could be sustained on the basis of domestic resources, and that significant cutbacks would be necessary. This is because an entirely domestically-funded programme would consume an unsustainable proportion of projected domestic revenues, requiring either a sharp increase in taxation or a large budget deficit, both of which would have highly negative economic impacts that would reduce economic growth.

# 5. Conclusion

Although the response to requests for data was disappointing, the study has nonetheless yielded some useful results. Specifically, we have derived some plausible, albeit uncertain, estimates of the split between domestic and foreign spending in HIV/AIDS programmes. The conclusion that approximately 60% of total spending is devoted to imported goods and services indicates that the net macroeconomic impact on the balance of payments (BoP), exchange rate, money supply, etc. is considerably less than the gross impact. If the same proportion applies to total spending (and the fact that data was received on two-thirds of spending suggests that the aggregate figure would not

[13] The "high funding" scenario assumes that generous donor support will continue to be provided, enabling a substantial scale-up from present levels of programme provision. However, it is below the "full funding" scenario that would enable full coverage of every intervention, and which would cost US$ 680 million by 2011/12; hence the envisaged scenario entails scaling down of some targets. For further details, see Section 4 of the NSP (Resource Requirements).

[14] The budgetary and macroeconomic impacts of GoU spending on HIV/AIDS are discussed in more detail in the Phase III report.

be much different) this then means that of the total estimated spending for HIV/AIDS programmes of US$ 418 million over the period 2003/04 to 2006/07, some US$ 243 million was spent on externally-sourced goods and services, while an estimated US$ 176 million was spent domestically.

Going forward, the proportion of total expenditure that will be spent externally is likely to increase, given that spending on ART drugs is set to rise sharply under the NSP 2007/08 – 2011/12, and this has the highest import component of any HIV/AIDS programme. However, to the extent that ART drugs are produced locally, the import content would be reduced, and this would tend to worsen the adverse macroeconomic impacts.

Given the concerns expressed by policymakers that the inflow of donor funding for HIV/AIDS programmes may cause macroeconomic disturbance, specifically by causing the exchange rate to appreciate or potential inflationary pressures, these results show that any such adverse developments would be substantially less than that suggested by the "headline" spending numbers. Furthermore, it is important that analysis of the macroeconomic impact of HIV/AIDS inflows takes account of the offsetting effect of external purchases of goods and services.

## Appendix 1 – Data Collection Form

| | | | | |
|---|---|---|---|---|
| **Implementing agent** | | | | |
| **Source of funding** | | | | |
| **Amounts received** | | | | |
| **Year/period** | | | | |

**Expenditure**

| | | | | |
|---|---|---|---|---|
| **Salaries** | Local | | | |
| | Foreign | | | |
| | Total | | | |
| **Allowances** | Local | | | |
| | Foreign | | | |
| | Total | | | |
| **Technical assistance** | Local | | | |
| | Foreign | | | |
| | Total | | | |
| **Drugs** | Local | | | |
| | Foreign | | | |
| | Total | | | |
| **Supplies** | Local | | | |
| | Foreign | | | |
| | Total | | | |
| **IEC Material** | Local | | | |
| | Foreign | | | |
| | Total | | | |
| **Monitoring & Evaluation** | Local | | | |
| | Foreign | | | |
| | Total | | | |
| **Training** | Local | | | |
| | Foreign | | | |
| | Total | | | |
| **Vehicles** | Local | | | |
| | Foreign | | | |
| | Total | | | |
| **Other (specify)** | Local | | | |
| | Foreign | | | |
| | Total | | | |

## Appendix 2: PEPFAR Uganda Partners: FY 2006

| Institution | Funding (US$) |
|---|---|
| African Medical and Research Foundation | 1,550,000 |
| AIDS Information Centre | 3,981,119 |
| Baylor University, College of Medicine | 2,737,252 |
| Catholic Relief Services | 8,784,303 |
| Chemonics International | 1,400,000 |
| Emerging Markets | 700,000 |
| Family Health International | 300,000 |
| HOSPICE AFRICA, Uganda | 900,000 |
| Integrated Community Based Initiatives | 905,000 |
| International HIV/AIDS Alliance | 1,100,000 |
| International Medical Corps | 225,000 |
| International Rescue Committee | 375,000 |
| John Snow, Inc. | 9,737,851 |
| Johns Hopkins University Center for Communication Programmes | 4,150,000 |
| Johns Hopkins University Institute for International Programmes | 200,000 |
| Joint Clinical Research Center, Uganda | 13,422,060 |
| Kumi Director of District Health Services | 795,000 |
| Makerere University Faculty of Medicine | 6,520,365 |
| Makerere University Institute of Public Health | 2,235,870 |
| Medical Research Council of Uganda | 600,000 |
| Mildmay International | 7,994,682 |
| Ministry of Health, Uganda | 2,575,000 |
| National Medical Stores | 3,900,000 |
| New York AIDS Institute | 300,000 |
| Population Services International | 3,004,929 |
| Protecting Families Against AIDS | 1,115,076 |
| Research Triangle International | 466,000 |
| Social and Scientific Systems | 1,350,000 |
| The AIDS Support Organisation | 16,863,700 |
| Uganda Virus Research Institute | 170,000 |
| University of California at San Francisco | 880,000 |
| US Agency for International Development | 3,178,818 |
| US Centers for Disease Control and Prevention | 10,613,639 |
| US Department of Defense | 225,000 |
| US Department of State | 315,734 |
| US Peace Corps | 600,700 |
| Walter Reed | 714,400 |

*Source: PEPFAR website*

# Appendix 3: Responses Received

| Organisation | Remarks |
|---|---|
| African Medical Research Foundation (AMREF) | Data required were received. |
| Africare | No data obtained yet. |
| AIDS Information Centre | Data required were received. |
| AVSI | Data required were received. |
| Baylor University | Data required were received, for 2006/07 only |
| Catholic Relief Services | Data required were received, for 2006/07 only |
| Christian Children's Fund | Data required were received. |
| Elizabeth Glaser Paediatric AIDS Foundation | Data required were received. |
| Family Health International - Uganda | No data obtained yet. |
| Health Communications Partnership | No data obtained yet. |
| Hospice Africa-Uganda | No data obtained yet. |
| IAVI – Entebbe | No data obtained yet. |
| International HIV/AIDS Alliance | Data required were received, for 2006/07 only |
| International religious council of Uganda | Data required were received. |
| International Youth Foundation | Data required were received, except for 2004/05 |
| Joint Clinical Research Centre | Data required were received. |
| Makerere University Rakai Project | No data provided |
| Makerere University Walter Reed Project | Data required were received |
| Mbarara-Mulago Joint AIDS Programme | Data required were received, except for 2004/05 |
| Medical Research Council | No data provided |
| Mildmay | Data required were received, except for 2004/05 |
| Ministry of Finance | Data required were received |
| Ministry of Health (ACP) | Data required were received, except for 2004/05 |
| Ministry of Local Government | Data required were received |
| National Medical Stores | Data required were received. |
| PEPFAR National Coordinator | Some data received, but with limited detail |
| Population Service International | Data required were received |
| Protecting Families Against HIV/AIDS | Data required were received, except for 2004/05 |
| Research Triangle International | Data required were received |
| The AIDS Support Organisation (TASO) | Data required were received. |
| Uganda AIDS Commission | Data required were received. |
| Uganda Blood Transfusion Services | Data required were received. |
| Uganda Global Fund AIDS, Tuberculosis and Malaria Project (UGFATMP) | Data required were received. |
| Uganda Virus Research Institute | Data required were received. |
| UNAIDS | Data available. |
| WHO | Data available. |
| World Vision International | No data provided |

# Chapter 5: The Demographic Impact of HIV/AIDS in Uganda

## 1. Introduction

The preparation of demographic projections is an essential component of modelling the macroeconomic impact of HIV/AIDS. A significant component of the macroeconomic impact results from the effect of HIV/AIDS on the population, and hence on the size and growth of the labour force. The labour force is in turn one of the main long-term drivers of economic growth, and also impacts on relevant indicators such as wages, employment, and the relative growth of different economic sectors.

The Spectrum model[15] was used to prepare demographic projections for this study. Spectrum has a number of advantages for this purpose, including its ease of use, and the relatively limited range of data that is needed to calibrate the model. It also has a module dedicated specifically to modelling the impact of HIV/AIDS (the AIDS Impact Module – AIM), and can produce a range of relevant outputs relating to the impact of HIV/AIDS on the population. It can also accommodate treatment interventions, such as the provision of ART.

Spectrum is widely used to make projections of population and resource needs in the context of HIV/AIDS. Amongst others, the Spectrum AIM is used by the Joint United Nations Programme on HIV/AIDS (UNAIDS) to make the national and regional estimates which are released once every two years. In Uganda, the Uganda Bureau of Statistics (UBOS) has prepared national population projections using the same model.
Spectrum requires the following inputs in order to provide basic demographic projections:

- Base year population (pre-HIV/AIDS).
- Life expectancy trends for males and females (in the absence of HIV/AIDS).
- Total fertility rate.
- Age specific fertility rate.
- Sex ratio at birth.
- International migration.
- Model life table

Spectrum provides default parameters for all of the above. However, in some cases the default parameters were replaced with actual Uganda data.

This study describes the process used to prepare the projections using Spectrum, and presents selected results.

## 2. Scenarios

Projections were prepared for four different scenarios:

[15] The Spectrum model is freely available at www.constellagroup.com/international-development/resources/software.php. Further details on Spectrum are provided at Appendix 1.

1. No AIDS.
2. AIDS with no ART provision.
3. AIDS with “low” ART provision.
4. AIDS with “high” ART provision.

The “No AIDS” scenario provides hypothetical population projections for Uganda in the absence of HIV/AIDS.

The “AIDS with No ART” scenario introduces HIV/AIDS into the projections, but does not include the impact of any treatment interventions.

The “AIDS with low ART” scenario also includes the impact of HIV/AIDS on the projections, but also includes the impact of the introduction of ART. It assumes that ART provision remains at relatively low levels.

The “AIDS with High ART” scenario also includes the impact of HIV/AIDS and ART provision on the projections. However, it assumes that ART provision continues to grow steadily from current levels.

All scenarios include population projections through to 2025.

# 3. Population Projections

## Basic Demographic Assumptions

The following assumptions were made to project the population to 2025.

**The Base Population:** The base population (year 0 of the projections) should ideally relate to a year prior to the beginning of the HIV/AIDS epidemic. Otherwise, it is not possible to derive a “No AIDS” scenario, because the impact of HIV/AIDS will already be factored into the base year population. This was somewhat problematic due to the limited availability of detailed historical census data, given that the base year population would have to be 1980 or earlier. The projections therefore used the “Easyproj” module of Spectrum, which uses data from UN Population Division. The initial population for 1980 taken from the projections is shown in Table 18.

**Table 18: Population in 1980 by Age & Gender**

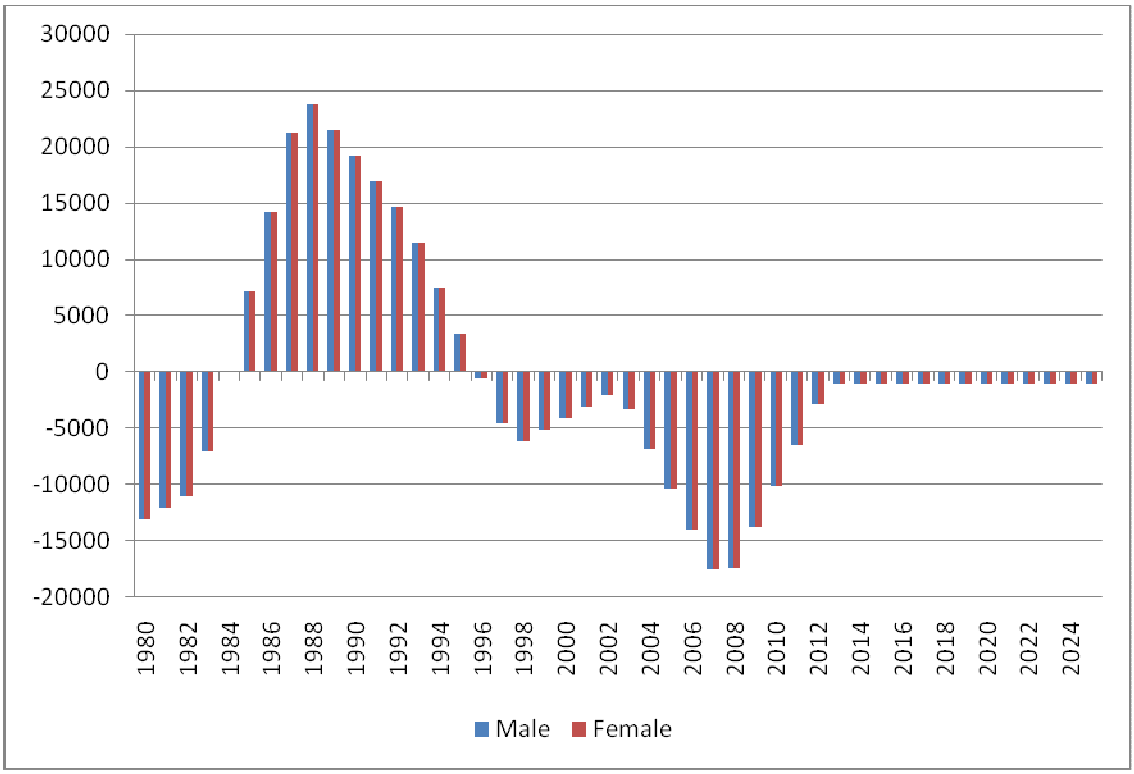
| Age group | Male | Female | Total |
|---|---|---|---|
| 0-4 | 1,256,700 | 1,242,000 | 2,498,700 |
| 5-9 | 999,100 | 989,600 | 1,988,700 |
| 10-14 | 814,100 | 809,700 | 1,623,800 |
| 15-19 | 642,100 | 641,800 | 1,283,900 |
| 20-24 | 522,700 | 527,500 | 1,050,200 |
| 25-29 | 429,000 | 437,800 | 866,800 |
| 30-34 | 357,300 | 362,400 | 719,700 |
| 35-39 | 292,800 | 296,700 | 589,500 |
| 40-44 | 217,500 | 221,900 | 439,400 |
| 45-49 | 200,700 | 206,100 | 406,800 |
| 50-54 | 162,900 | 169,900 | 332,800 |
| 55-59 | 128,400 | 136,800 | 265,200 |
| 60-64 | 97,000 | 103,900 | 200,900 |
| 65-69 | 67,600 | 74,500 | 142,100 |
| 70-74 | 43,400 | 49,700 | 93,100 |
| 75-79 | 24,000 | 29,400 | 53,400 |
| 80+ | 13,400 | 18,500 | 31,900 |
| **Total** | 6,268,700 | 6,318,200 | 12,586,900 |

*Source: Spectrum model*

**Sex Ratio at Birth:** Spectrum requires information on the sex ratio of the population at birth. Whereas it is appreciated that vital registration provides the most appropriate source of information on sex ratio at birth, the coverage of vital registration in Uganda is still very limited. From the UDHS results, the sex ratio at birth was estimated at 102.6 males per 100 females since 1980 and this was assumed constant throughout the projection period.

**Net Migration:** Spectrum uses data migration from UN sources. Estimates are shown in Figure 26 below. Flows of migrants are determined largely by changing political and humanitarian circumstances in regional states. Historical data are used where available. Going forward, projected flows are relatively small.

**Figure 26: International Migration**

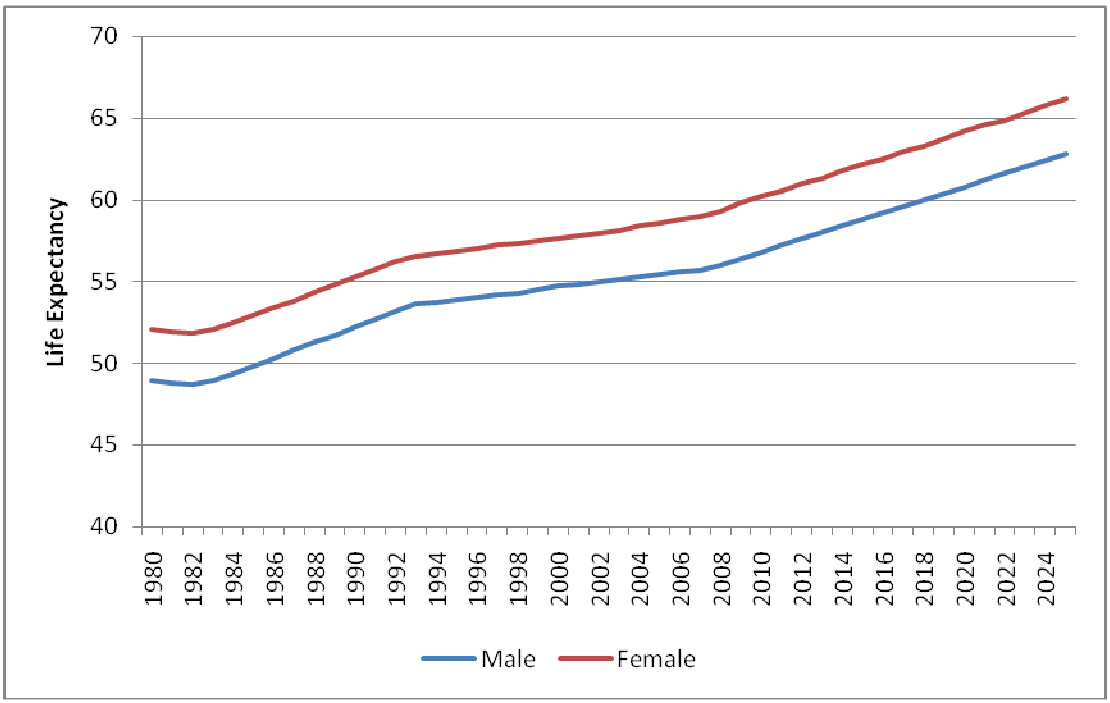



*Source: Spectrum model*

**Fertility:** It was assumed that total fertility rates (TFR) will continue to decline as noted between the Censuses of 1991 (7.0) and 2002 (6.7). If this trend continues, it is assumed that by 2025, the TFR will then be 5.9. The TFR in 1980 was assumed to be 7.1.

**Life Expectancy:** Spectrum requires life expectancy figures *in the absence of HIV/AIDS*. The figures used were those generated by the model and are shown in Figure 27 below.

**Figure 27: Life Expectancy, Male & Female**




*Source: Spectrum model*

## HIV/AIDS Projections

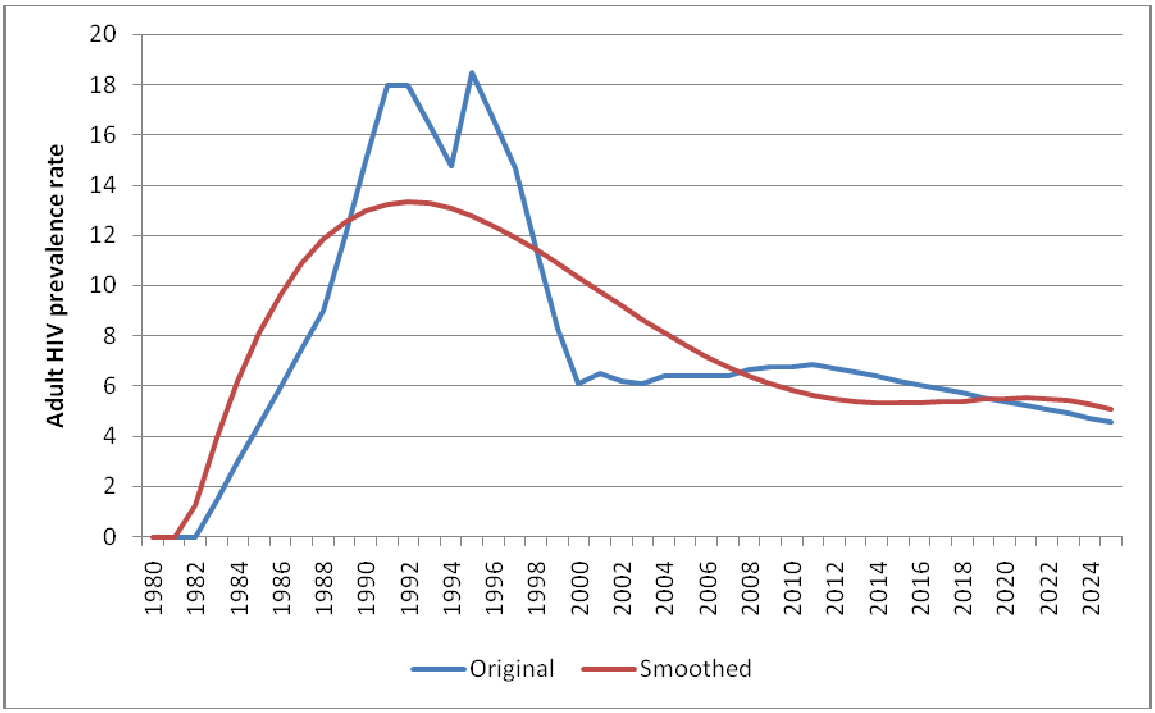
The AIM of Spectrum requires information on various parameters associated with HIV/AIDS. These include the adult HIV prevalence rate, HIV age distribution, the fertility impact of HIV/AIDS, the survival time after infection, and the extent of interventions. The assumptions and parameters are discussed below.

**Adult HIV/AIDS Prevalence:** Estimates of HIV/AIDS prevalence rates for Uganda are available from different sources. However, prior to the advent of sentinel survey testing of pregnant women, estimates are of uncertain reliability with regard to national prevalence rates, and tend to reflect prevalence in specific localities. Uganda AIDS Commission (2001) quotes adult HIV prevalence rates of 9% for 1988, rising to 18.5% in 1995, and falling to 8.3% in 1999[16]. As per the Sero-Behavioural survey of 2004/05, the prevalence was estimated at 6.4%. Following this trend, the prevalence was projected to be 4.5% in 2025.

Plotting the publicly available prevalence rates shows a series that does not appear to represent a normal epidemiological trend, with discontinuities that do not occur in practice. This may reflect the fact that data on HIV prevalence were taken from a variety of sources. Therefore, in order to generate usable HIV prevalence rates, the series was smoothed[17]. The smoothed series shows a lower peak in HIV prevalence and a more gradual decline than the original data. Both the original and smoothed series are shown in Figure 28 below.

[16] *Twenty Years of HIV/AIDS in the World: Evolution of the Epidemic and Response in Uganda* (UAC, 2001).
[17] The smoothing was applied by fitting a 4th-order polynomial function in Excel.

**Figure 28: Adult HIV Prevalence**




*Source: UAC, UBOS*

Age- and gender-specific adult HIV prevalence rates were taken from the results of the 2004/05 sero-behavioural survey, as in Table 19 below.

**Table 19: Adult HIV Prevalence, 2004/05 (%)**

| Age cohort | M | F |
|---|---|---|
| 15-19 | 0.03 | 2.6 |
| 20-24 | 2.4 | 6.3 |
| 25-29 | 5.9 | 8.7 |
| 30-34 | 8.1 | 12.1 |
| 35-39 | 9.2 | 9.9 |
| 40-44 | 9.3 | 8.4 |
| 45-49 | 6.9 | 8.2 |
| 50-54 | 6.9 | 5.4 |
| 55-59 | 5.1 | 7.4 |

*Source: Uganda HIV/AIDS Sero-Behavioural Survey, 2004/05*

In the absence of the data about the effect of HIV/AIDS on fertility, the default estimates were used (see Table 20). The model assumes that fertility is not affected by the provision of ART. In practice this may not be the case, as ART could offset some of the negative impacts on fertility that are associated with HIV infection. A study addressing this issue was conducted in Mbarara in 2005-06, which tracked the fertility desire and history amongst 500 HIV+ women[18]. The study found that ART use was associated with increased probability of fertility desire but decreased probability of

[18] Emenyonu N, Maier M, Andia-Biraro I, Kaida A, Hogg R, and Bangsberg D: *ART, Fertility Desire and Recent Fertility History of HIV+ Ugandan Women*

pregnancy and live birth. Hence there was no evidence that ART use increased *actual* (as opposed to desired) fertility.

**Table 20: Ratio of Fertility of HIV-Infected Women to the Total Fertility of Uninfected Women**

| Age | Ratio |
|---|---|
| 15-19 | 1.5 |
| 20-24 | 0.7 |
| 25-29 | 0.7 |
| 30-34 | 0.7 |
| 35-39 | 0.7 |
| 40-44 | 0.7 |
| 45-49 | 0.7 |

*Source: Spectrum Model*

The other default values from Spectrum used in the model are shown in Table 21, showing the cumulative number of people dying of HIV/AIDS taking a slow pattern for both adult and children. The average (median) time from infection to death without ART is 11 years for both male and female adults, and approximately six years for children. It should be noted that this does not mean that all HIV+ people will die after a fixed time; rather, there is a probability distribution of deaths, whereby some will die quickly while others will survive for a long time even without treatment.

**Table 21: Cumulative Percentage of People Dying from HIV/AIDS by Number of Years since Infection, without ART**

| Year | Male | Female | Children |
|---|---|---|---|
| 1 | 0 | 0 | 25 |
| 2 | 0 | 0 | 34 |
| 3 | 1 | 1 | 39 |
| 4 | 4 | 4 | 43 |
| 5 | 7 | 7 | 47 |
| 6 | 11 | 11 | 49 |
| 7 | 17 | 17 | 51 |
| 8 | 24 | 24 | 53 |
| 9 | 32 | 32 | 55 |
| 10 | 41 | 41 | 57 |
| 11 | 50 | 50 | 58 |
| 12 | 58 | 58 | 59 |
| 13 | 65 | 65 | 60 |
| 14 | 71 | 71 | 62 |
| 15 | 76 | 76 | 63 |
| 16 | 82 | 82 | 64 |
| 17 | 85 | 85 | 65 |
| 18 | 87 | 87 | 66 |
| 19 | 87 | 87 | 67 |
| 20 | 87 | 87 | 68 |

*Source: Spectrum model*

## Treatment Scenarios

Two different treatment scenarios were modelled.

Low ART: assumes that ART provision remains at relatively low levels, and peaks at around 45% of the adult population with advanced HIV infection receiving ART. It also assumes that 90% of those on ART at any time survive until the next year.

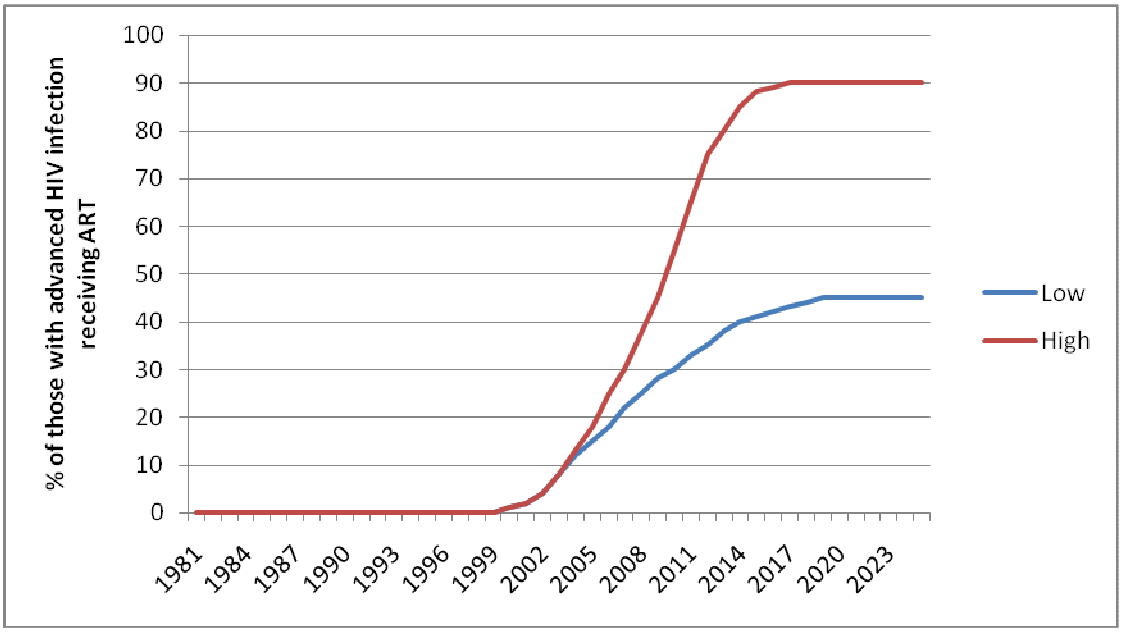
High ART: assumes that ART provision continues to grow steadily from current levels until 90% of the clinically-eligible population is reached, and that 95% of those on ART at any time survive until the next year.

A pilot study of treatment adherence and drug resistance conducted in Uganda between 1998 and 2000 gave encouraging results[19]. It found that as long as an effective drug supply chain could be maintained, people in therapy reported good adherence, and viral and immune responses were similar to those seen in North America and Europe.

The projections generated here assume that ART take-up does not vary between men and women (i.e. that equal proportions of eligible HIV+ men and women take up treatment, and that adherence is also independent of gender). While this may not be the case in practice, there is no reliable data on different take-up and adherence rates by gender, and the Spectrum model does not disaggregate ART treatment by gender.

The percentage of those with advanced HIV infection receiving ART under the two scenarios is shown in Figure 29 below.

**Figure 29: ART Rollout**




*Source: Own projections*

## 4. Population Estimates

The estimates of the total population in the four scenarios are shown in Figure 30 below.

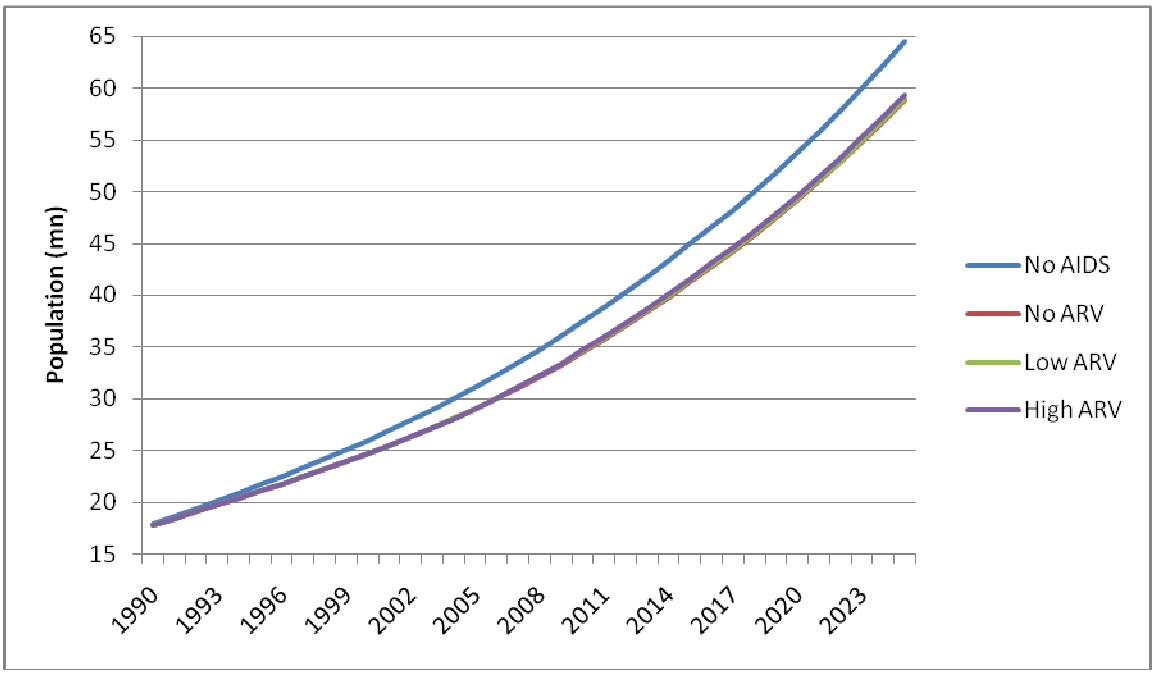
The results for all four scenarios are shown in this exercise (No AIDS, AIDS with No ART, Low ART and High ART).

The results show that there was little difference in the projected population in the different scenarios through the 1980s (which may indicate that the model projections are somewhat delayed

[19] Weidle P *Assessment of a pilot anti-retroviral drug therapy programme in Uganda: patients' response, survival and drug resistance*.

in incorporating the initial impacts of HIV/AIDS, as AIDS-related deaths in the model during the 1980s are few).

**Figure 30: Total Population**

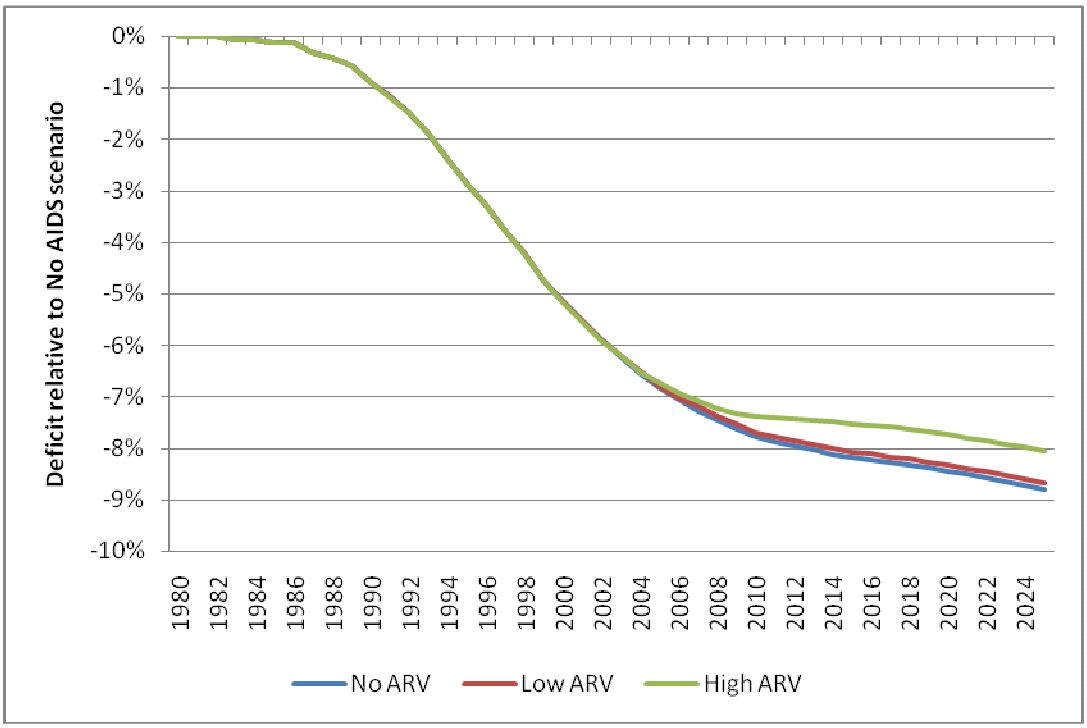



*Source: Model projections*

The "No HIV/AIDS" scenario puts Uganda's total population in the year 2025 at 64.5 million. The age- and gender-specific projections are as shown in Table 5 below. Putting HIV/AIDS into the projections, without ART, a lower population of 58.8 million is estimated for 2025.

There are reasons to believe that Spectrum may be over-estimating the population. Under the "With-AIDS" scenario, the projections show a total population of 26.3 million for 2002. This compares with the observed census result for 2002, of 24.2 million people. It is not clear why this is so, but suggests (if the census results are correct) that Spectrum is over-estimating the population by some 10%. However, the main purpose of the present exercise is to compare projections under the different scenarios (With/Without AIDS, etc.), and there is no reason to believe that comparative projections are misaligned. These suggest that by 2002, HIV/AIDS had caused the Ugandan population to be some 6% smaller than it would have been without HIV/AIDS, while by 2025 the difference would be 9% (see Figure 31).

**Figure 31: Population Deficit due to HIV/AIDS**

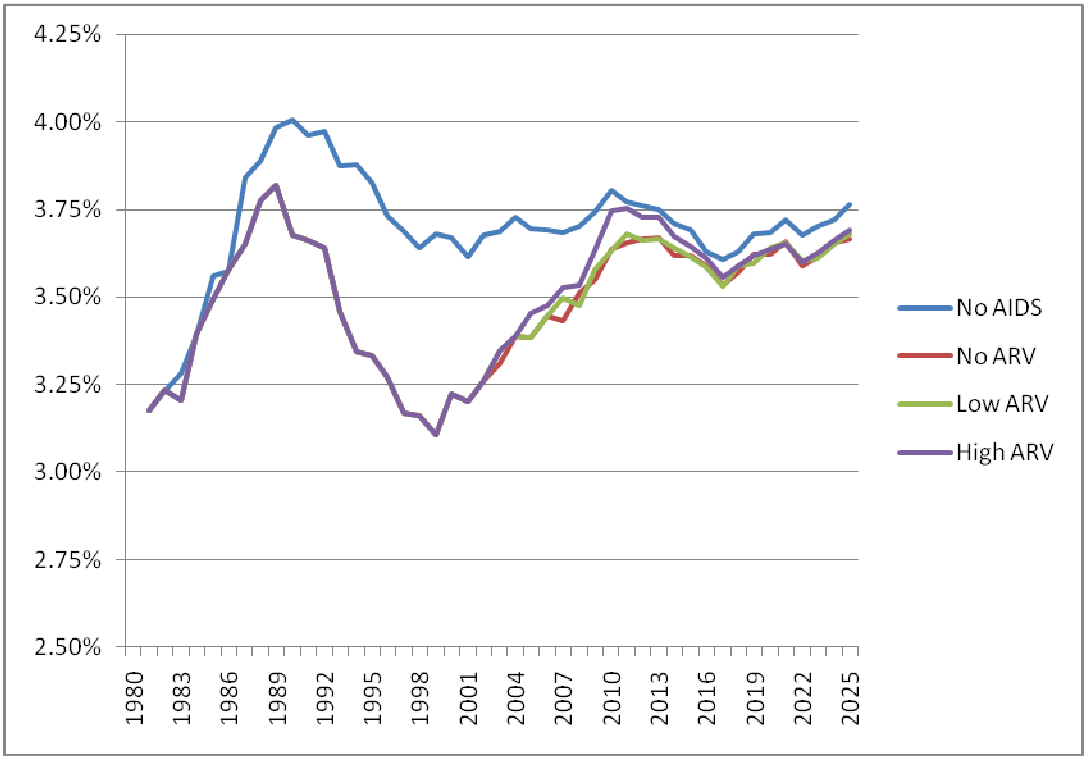



*Source: Model projections*

**Population Growth:** The projections also show the impact of HIV/AIDS on population growth (see Figure 32). These show that the main impact of HIV/AIDS was felt during the early 1990s, when prevalence rates were relatively high. As prevalence rates fell during the late 1990s, population growth is estimated to have risen, such that in the High ART scenario, it is almost up to the growth rate projected for the "Without AIDS" scenario.

The projections show that even in the absence of HIV/AIDS, population growth declined during the late 1990s. This is due to a combination of factors, including disruptive internal population movements and out-migration (refer to Figure 26), as well as the expected natural decline in fertility from very high rates.

### Figure 32: Population Growth Rates




*Source: Model projections*

### Table 22: Population Projections by Age and Gender for 2025 (million)

| | No HIV/AIDS | | | HIV/AIDS (No ART) | | |
|---|---|---|---|---|---|---|
| **Age group** | **Total** | **Male** | **Female** | **Total** | **Male** | **Female** |
| 0-4 | 12.22 | 6.16 | 6.06 | 11.24 | 5.66 | 5.58 |
| 5-9 | 9.94 | 5.00 | 4.94 | 9.20 | 4.63 | 4.57 |
| 10-14 | 8.49 | 4.26 | 4.22 | 7.89 | 3.96 | 3.93 |
| 15-19 | 7.09 | 3.55 | 3.54 | 6.59 | 3.30 | 3.29 |
| 20-24 | 5.68 | 2.84 | 2.84 | 5.27 | 2.64 | 2.63 |
| 25-29 | 4.66 | 2.32 | 2.33 | 4.33 | 2.17 | 2.16 |
| 30-34 | 3.84 | 1.91 | 1.93 | 3.60 | 1.81 | 1.78 |
| 35-39 | 3.09 | 1.53 | 1.55 | 2.86 | 1.44 | 1.41 |
| 40-44 | 2.43 | 1.20 | 1.23 | 2.19 | 1.10 | 1.08 |
| 45-49 | 1.95 | 0.96 | 0.99 | 1.68 | 0.85 | 0.83 |
| 50-54 | 1.55 | 0.76 | 0.79 | 1.27 | 0.64 | 0.62 |
| 55-59 | 1.20 | 0.58 | 0.62 | 0.91 | 0.45 | 0.46 |
| 60-64 | 0.87 | 0.42 | 0.45 | 0.64 | 0.30 | 0.34 |
| 65-69 | 0.62 | 0.29 | 0.33 | 0.46 | 0.20 | 0.25 |
| 70-74 | 0.42 | 0.19 | 0.22 | 0.32 | 0.14 | 0.18 |
| 75-79 | 0.25 | 0.11 | 0.14 | 0.21 | 0.09 | 0.12 |
| 80+ | 0.21 | 0.09 | 0.12 | 0.19 | 0.08 | 0.11 |
| **Total** | **64.50** | **32.20** | **32.30** | **58.82** | **29.48** | **29.35** |

*Source: Model projections*

The projections also show the impact of providing ART on the total population. As Figure 31 above shows, the provision of ART – even in the High ART scenario – only closes part of the population gap between the "No AIDS" and "With AIDS" scenarios. In the Low ART scenario, the population in 2025 is only 0.1% higher than in the "No ART" scenario, while in the High ART scenario the population is 0.8% higher than in the "No ART" scenario.

The reason for the apparently small impact of ART provision is that a large proportion of the impact on the total population was felt during the late 1980s and the early 1990s, where high HIV-prevalence and death rates had a permanent effect, making the population smaller. The projections also show that unless ART is widely provided, it pays little demographic dividend.

**Table 23: Population Projections by Age and Gender for 2025 (million) – "With ART" Scenarios**

| | Low ART | | | High ART | | |
|---|---|---|---|---|---|---|
| **Age group** | **Total** | **Male** | **Female** | **Total** | **Male** | **Female** |
| 0-4 | 11.25 | 5.67 | 5.58 | 11.31 | 5.7 | 5.61 |
| 5-9 | 9.21 | 4.63 | 4.58 | 9.25 | 4.66 | 4.6 |
| 10-14 | 7.9 | 3.97 | 3.93 | 7.94 | 3.99 | 3.95 |
| 15-19 | 6.59 | 3.3 | 3.29 | 6.61 | 3.31 | 3.3 |
| 20-24 | 5.27 | 2.64 | 2.63 | 5.27 | 2.64 | 2.64 |
| 25-29 | 4.34 | 2.17 | 2.16 | 4.35 | 2.17 | 2.17 |
| 30-34 | 3.6 | 1.81 | 1.79 | 3.63 | 1.82 | 1.81 |
| 35-39 | 2.87 | 1.45 | 1.42 | 2.91 | 1.47 | 1.45 |
| 40-44 | 2.2 | 1.11 | 1.09 | 2.25 | 1.14 | 1.12 |
| 45-49 | 1.69 | 0.86 | 0.83 | 1.74 | 0.88 | 0.86 |
| 50-54 | 1.27 | 0.64 | 0.63 | 1.29 | 0.66 | 0.64 |
| 55-59 | 0.91 | 0.45 | 0.46 | 0.92 | 0.46 | 0.47 |
| 60-64 | 0.64 | 0.3 | 0.34 | 0.64 | 0.3 | 0.34 |
| 65-69 | 0.46 | 0.2 | 0.25 | 0.46 | 0.21 | 0.25 |
| 70-74 | 0.32 | 0.14 | 0.18 | 0.32 | 0.14 | 0.18 |
| 75-79 | 0.21 | 0.09 | 0.12 | 0.21 | 0.09 | 0.12 |
| 80+ | 0.19 | 0.08 | 0.11 | 0.19 | 0.08 | 0.11 |
| **Total** | **58.90** | **29.51** | **29.39** | **59.31** | **29.70** | **29.61** |

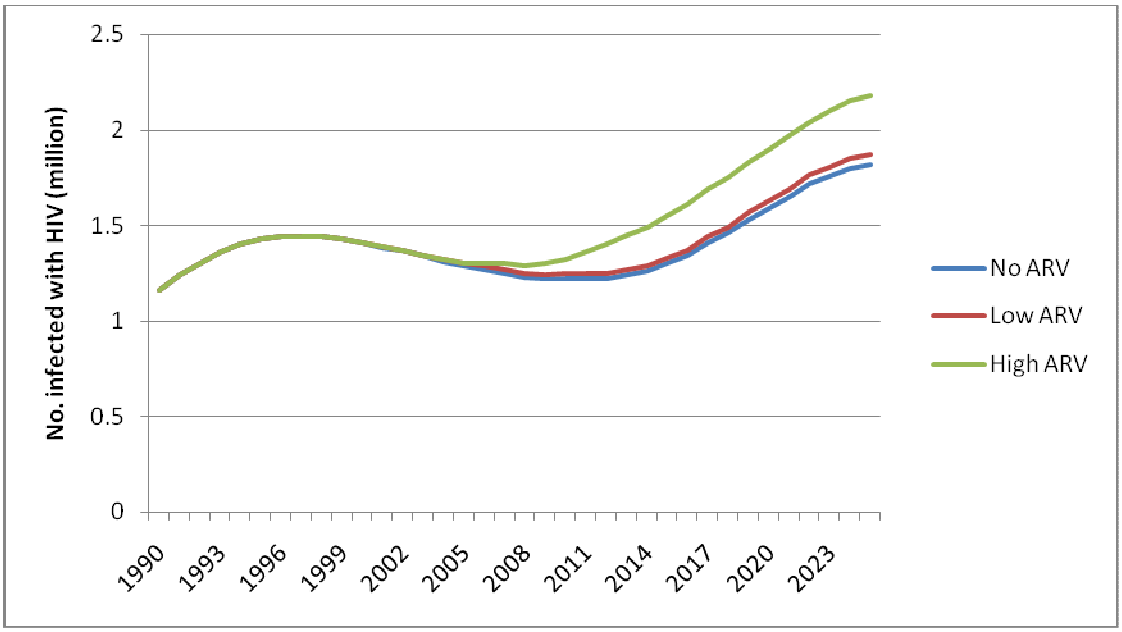
*Source: Model projections*

# 5. Further Analysis of the Impact of HIV/AIDS and the Provision of ART

**HIV Population**: As can be seen in Figure 33, the number of people infected with HIV is estimated to have peaked at about 1.4 million in 1996, before falling slowly. Without ART, the number of HIV+ people would continue to decline through to about 2012, following which time it would start to rise. This reflects a number of factors. First, population growth – even with a constant prevalence rate, if the population is growing then the number of those infected with HIV will rise. Second, there are indications that the prevalence rate has been rising slightly (see Figure 28 and Figure 34), which reinforces the upward trend in numbers infected.

With ART, the increase in the numbers of HIV+ people is even more dramatic, especially in the High ART scenario. The rollout of ART increases the number of HIV+ people, as those who would have earlier died are now living longer. The striking impact of this is shown in Figure 33. By 2025 there are projected to be 2.2 million HIV+ people under the High ART scenario, but only 1.8 million in the absence of ART.

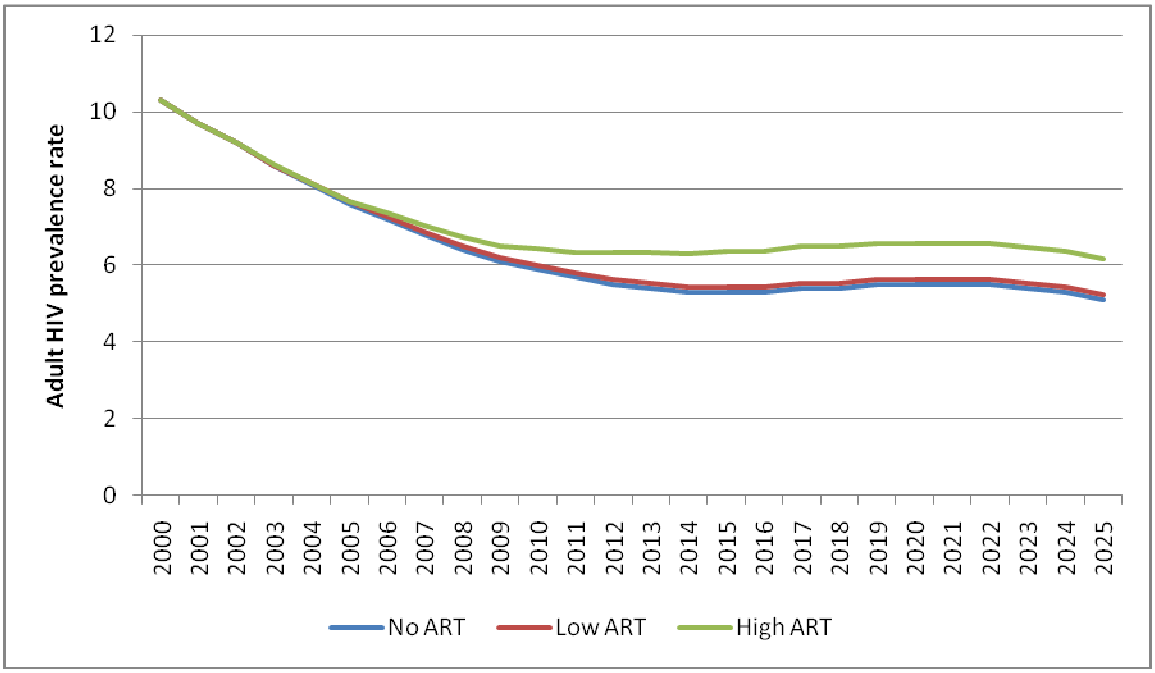
**Figure 33: Number of People Infected with HIV/AIDS**




*Source: Model projections*

**HIV Prevalence**: Figure 34 shows the impact of ART provision on HIV prevalence. Although it is projected that there is an underlying trend of declining prevalence, the impact of ART provision on keeping people alive raises the overall prevalence rate. In the absence of ART provision, the adult HIV prevalence rate is projected to fall to 5.1% in 2025. With ART, however, the prevalence rate is projected to be higher, at 6.2%.

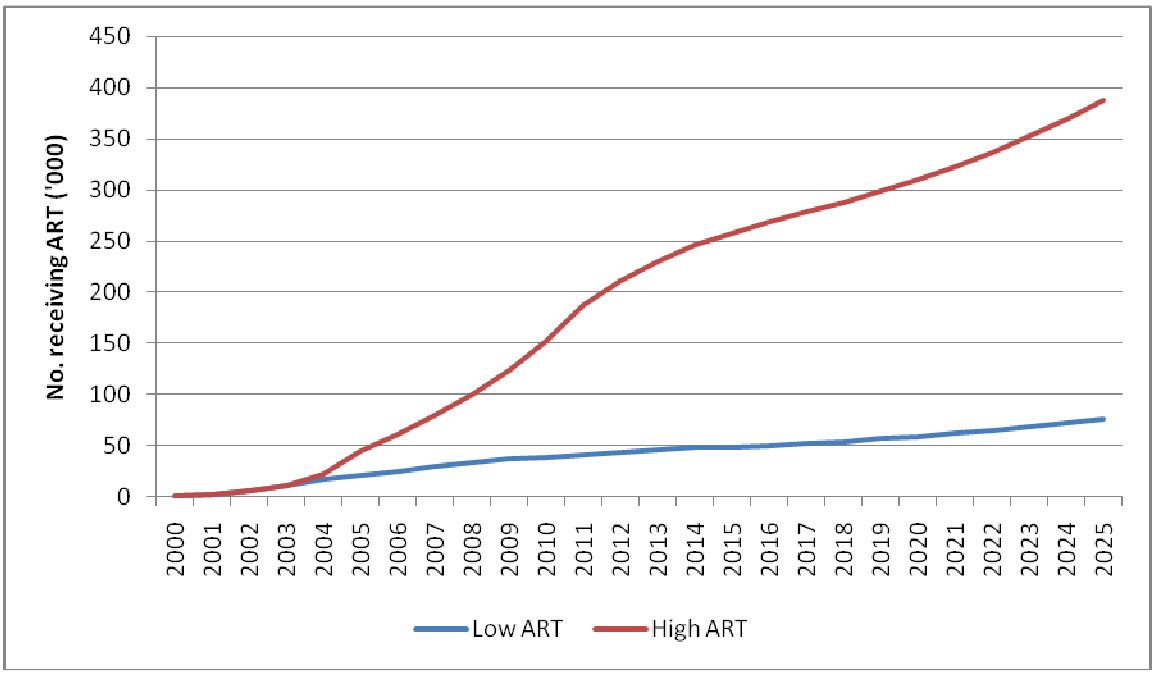
**Figure 34: Adult HIV Prevalence**




*Source: Model projections*

**Number Receiving ART:** The number of people receiving ART continues to rise in both the Low and High ART scenarios, although much more dramatically in the latter (see Figure 35). The number receiving ART in the High scenario is close to, but somewhat below, the projections contained in the NSP. This may indicate that the model is under-projecting the number of HIV+ people, or that the NSP envisages earlier treatment of HIV+ people with ART than the protocols embedded in the Spectrum model. It is unlikely to reflect a faster rollout of ART in the NSP, as the High scenario envisages a very rapid rollout of ART.

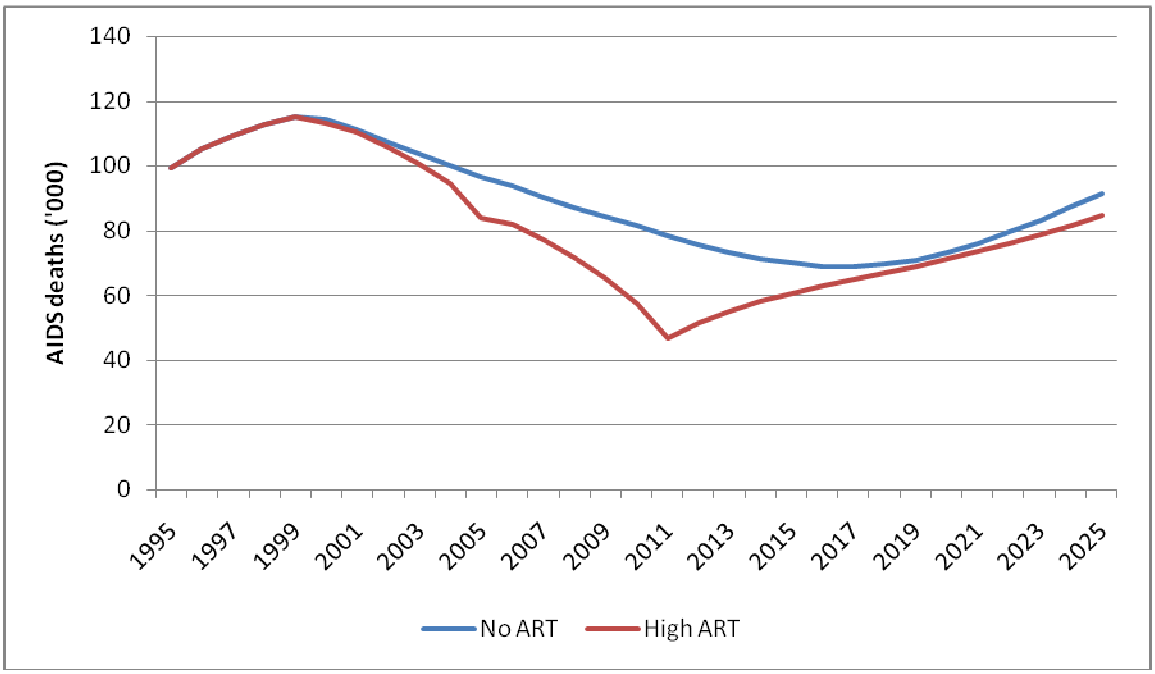
**Figure 35: Number of Adults Receiving ART**




*Source: Model projections*

**AIDS-related Deaths and Life Expectancy**: Figure 36 shows that the number of deaths as a result of HIV/AIDS has been falling since the late 1990s, reflecting the earlier decline in HIV prevalence. Going forward, the number of projected AIDS-related deaths is highly dependent upon the rollout of ART. Under the High ART scenario, the number of AIDS-related deaths is projected to keep falling steadily until around 2011, when ART provision levels out at 90% of the relevant eligible population. During this period, the rapid rollout of ART dramatically cuts the number of AIDS-related deaths. After 2011, the number of AIDS-related deaths starts rising again. It should be noted that the provision of ART delays AIDS-related deaths but does not prevent them, due to various factors associated with ART, including patients' adherence lapses and the emergence of drug resistance. In the medium term, however, it is clear that ART leads to a significantly reduced death rate and hence improved life expectancy. Without ART (or in theLow ART scenario), the number of deaths is projected to decline much more slowly, reflecting only the earlier decline in prevalence. Eventually, however, the number starts rising, following the increase in the number of HIV+ people in the population.

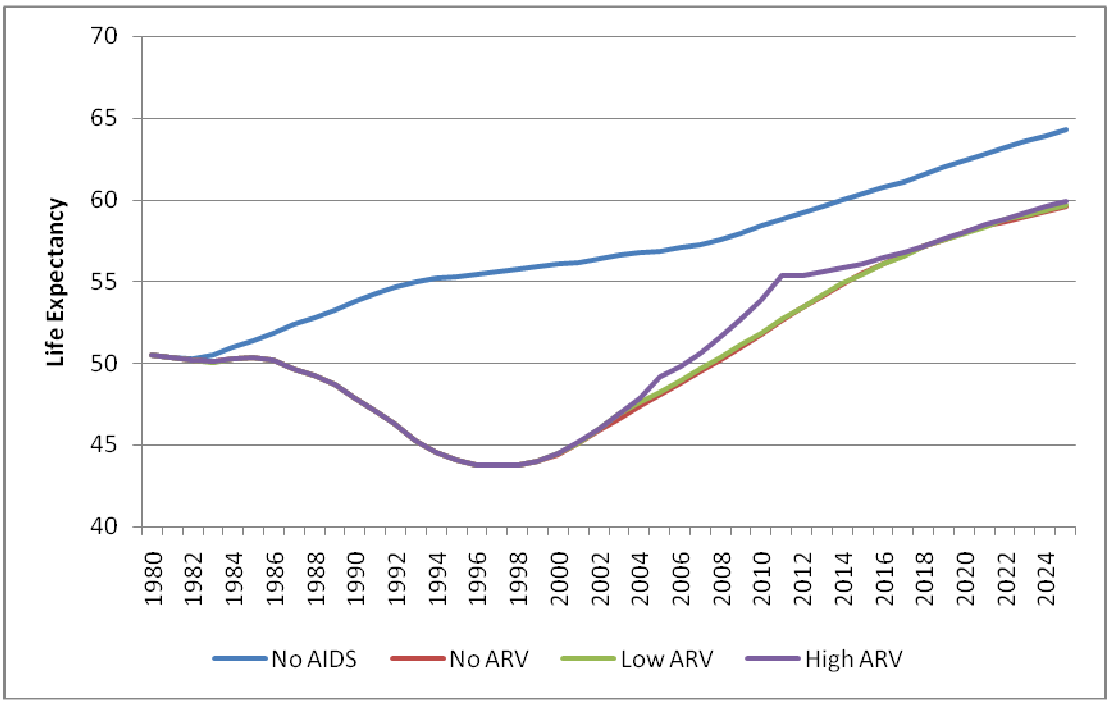
**Figure 36: AIDS-related Deaths**




*Source: Model projections*

The overall impact of HIV/AIDS on life expectancy is shown in Figure 37. This shows that by the late 1990s, life expectancy had fallen to an estimated 44 years, compared to 56 years in the period without HIV/AIDS. However, going forward, the gap declines, reflecting the decline in the HIV prevalence rate and, in the High ART scenario, the availability of treatment that prolongs survival times for HIV+ individuals. By 2025, life expectancy is projected to be 60 years in the "With-AIDS" scenarios, compared to an estimated 64 years "Without AIDS".

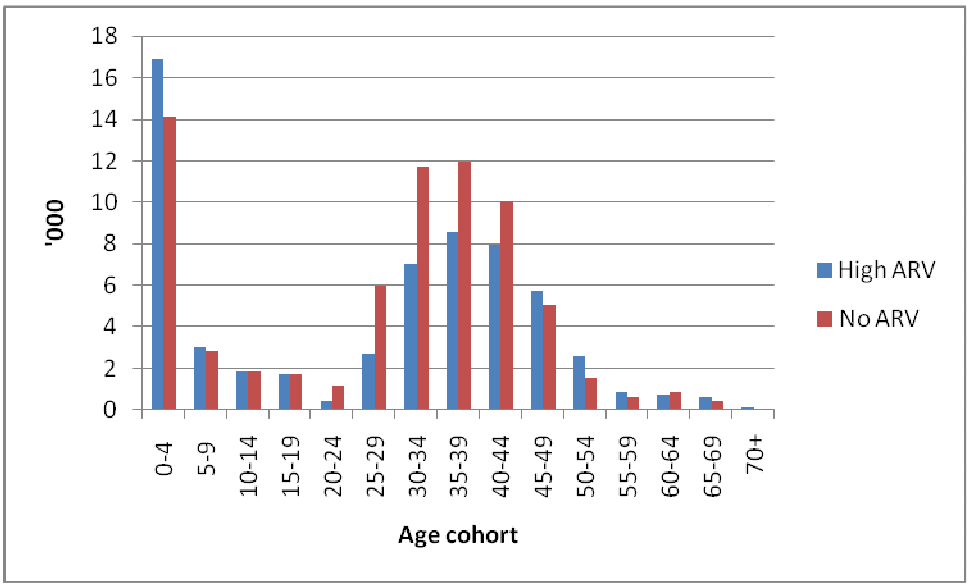
**Figure 37: Life Expectancy**




*Source: Model projections*

**AIDS-related Deaths and the Labour Force**: In populations without HIV/AIDS, death rates tend to be higher for the elderly and very young children than for the general population as a whole. This largely reflects the impact of disease relative to levels of health and bodily resistance to infection. However, HIV/AIDS changes the pattern of deaths, and the age pattern of death rates are quite different in a population that has high HIV prevalence than one without. HIV/AIDS tends to raise the number of deaths amongst young and middle-aged adults, i.e. those who are economically most productive and who are more likely to be skilled and employed. Hence investments made by the government and other agencies to sustain the lives of the infected persons, will to some degree, be balanced by the economic contributions of the same people. As shown in Figure 38, provision of ART will have a significant effect on reducing AIDS-related deaths among the economically productive age group of 15-59 years.

**Figure 38: Age-specific AIDS-related Deaths in 2015**



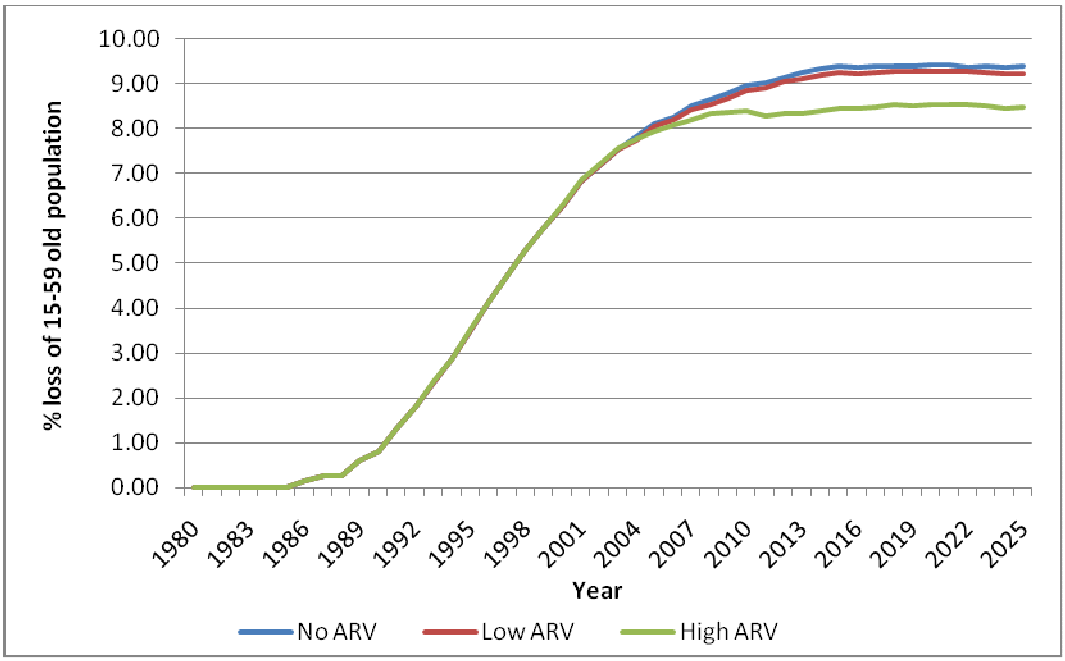

*Source: Model projections*

AIDS-related deaths are mainly concentrated in people of productive age, implying that Uganda has been losing a large number of the country's potential labour force (15-59 year old) since the late 1980s[20]. A sharp increase in these deaths was recorded in the 1990s, when the HIV prevalence was at its peak. Thereafter, the death rate started declining as HIV prevalence declined.

In view of the potential economic impact of losing the most productive age group of the population, the Spectrum model has been used to make projections of the likely loss of labour force that the country may face in the period up to 2025. Under the different scenarios modelled, in the absence of ART, the country will have lost 8.5% of the labour force (compared to the No-AIDS scenario) by 2025. However, this can be reduced slightly (8.4%) in the low case scenario of ART. A bigger impact is visible (7.7%) in the High ART scenario.

[20] Although the Spectrum model has looked at the 15-59 population, this is driven by the model and international conventions regarding the definition of the labour force. It does not mean that people do not engage in economic activities before they are 15 years or when they are 60 years and above.

**Figure 39: Projected Loss of Labour Force (15-59 yrs)**

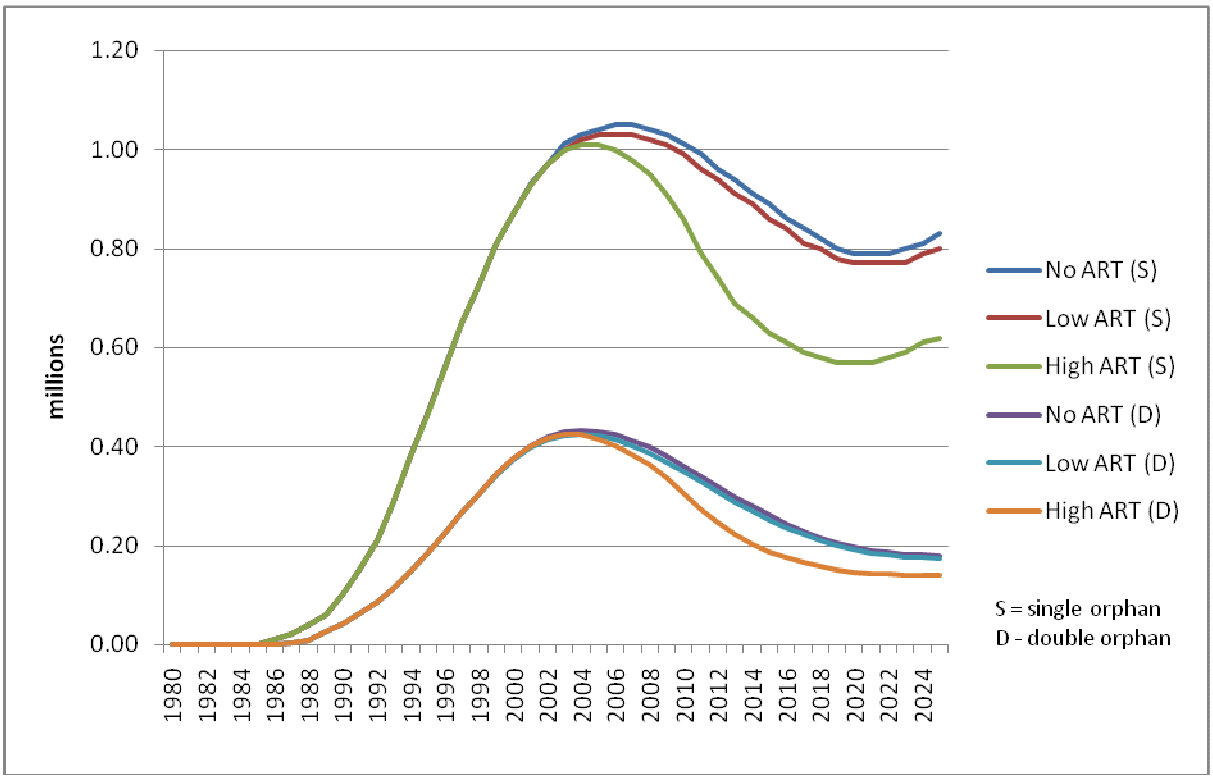



*Source: Model projections*

**Orphans:** The number of children orphaned to HIV/AIDS (both double and single orphans[21]) started rising in the late 1980's and steadily increased through the early 1990s. However, the rate of increase tended to decrease in late 1990s, which could be attributed to decline in the HIV prevalence rate at the time. The number of orphans has recently peaked at just over one million. Without the intervention of ART, the total number of HIV/AIDS-orphaned children is estimated to be 830,000 in 2025. With ART, the number of orphans is expected to be lower. The Low ART scenario only leads to small difference in the number of orphans, which would be 800,000 in 2025, whereas in the High ART scenario the number would be much lower, at 620,000 (see Figure 40). For double orphans, the numbers are much lower, peaking at around 400,000 and declining to under 200,000 by 2025.

[21] Double orphans have lost both parents to HIV/AIDS while single orphans have lost either their mother or father.

**Figure 40: Orphan Projections (Double & Single)**




*Source: Model projections*

## 6. Conclusions and Implications

The population projections detailed here do have some limitations. In particular, there is little gender disaggregation related to the provision and uptake of ART, even though in practice the behaviour of men and women may be quite different. This issue can be dealt with in future once more disaggregated data are available and the Spectrum model can generate projections on this basis. A further limitation is that the impact of ART on fertility is not accommodated, but again this can be reflected in future once reliable data are available based on empirical research.

The main findings of this demographic study of HIV/AIDS in Uganda are as follows:

- The main demographic impact of HIV/AIDS has already occurred, i.e. during the 1980s and early 1990s when HIV prevalence was very high, and there were large numbers of AIDS-related deaths. As a result, the differences between the various scenarios going forward (e.g. in terms of population deficit) are not very large. Going forward, however, there are differences between the High ART and No/Low ART scenarios, in terms of the size of the population, the numbers of HIV+ individuals, and the numbers of AIDS-related deaths. However, the differences between the Low ART and No ART scenarios are minimal, and in some cases indistinguishable, which indicate that a Low ART approach will yield few demographic benefits (or social and economic benefits).
- In the High ART scenario, the number of AIDS-related deaths is cut over a fifteen year period from around 2003 to 2018. Towards the end of the projection period, however, the number of AIDS-related deaths is similar in both the High ART and No ART scenarios, essentially as a "catch-up" process takes place. It is important to realise that ART does not keep all HIV+

individuals alive indefinitely, and that problems of insufficient adherence to treatment regimens and emerging drug resistance will mean that some of those taking ART will eventually die of AIDS-related illnesses. Importantly, however, they will have enjoyed many extra years of fulfilling healthy life in the meantime.

- The widespread provision of ART (as in the High ART scenario) is a long-term, open-ended commitment, which continues to grow during the period of the projections. Hence it is important that efforts to prevent the spread of HIV/AIDS and reduce new infections (incidence) are pursued, as this is the only long-term solution to the epidemic. It is especially important that the heightened focus on treatment does not detract from the long-term need for effective prevention.
- Life expectancy is higher in the High ART scenario, but does not recover to the levels that would have been experienced without HIV/AIDS.
- The number of orphans (who have lost one or both parents to AIDS) peaked at just over one million, or around 3% of the population. Providing ART cuts the number of orphans by around one-quarter by 2025.
- By keeping HIV+ individuals alive for longer, the High ART scenario will lead to a higher HIV prevalence rate, reinforcing the point that trends in HIV prevalence are not a good indicator of the success or otherwise of HIV-prevention efforts in an environment of widespread ART provision, and the focus has to be on incidence (not prevalence) rates.

# Annex: Description of the Spectrum and AIDS Impact Models [22]

## Spectrum Policy Modelling System

Spectrum is a computer programme for making population projections, but which is particularly suited for modelling the impact of HIV/AIDS and the impact of policy interventions. It is based on the analysis of existing information to determine the future consequences of various development programmes and policies.

The Spectrum Policy Modelling System comprises an integrated package containing the following components:

**Demography (DemProj):** A programme to make population projections based on (1) the current population, and (2) fertility, mortality, and migration rates for a country or region.

**AIDS Impact Model (AIM):** AIM projects the consequences of the HIV/AIDS epidemic, including the number of people living with HIV/AIDS, new infections, and AIDS-related deaths by age and sex as well as new cases of tuberculosis and AIDS orphans.

**BenCost:** Financial benefits and costs of family planning programmes.

**Allocate:** Impact of resource allocation to different components of a reproductive health action plan.

**Condom Requirements:** A programme to forecast national condom requirements for both family planning and HIV/AIDS prevention.

**FamPlan:** Projects family planning requirements needed to reach national goals for addressing unmet need or achieving desired fertility.

**NewGen:** Reproductive health for adolescents.

**PMTCT:** Prevention of mother-to-child transmission.

**RAPID**: Projects the social and economic consequences of high fertility and rapid population growth for such sectors as labour, education, health, urbanisation, and agriculture.

**Safe Motherhood:** Represents the relationships between a national maternal health programme and the resulting maternal mortality ratio (MMR) and the number of maternal deaths.

This study makes use of DemProj and AIM. DemProj is at the heart of the Spectrum suite of models as it is used to create the population projections that support many of the calculations in the other components, such as FamPlan, Benefit-Cost, AIM, and RAPID.

The Spectrum Policy Models are designed to answer a number of “what if” questions. The “what if” refers to factors that can be changed or influenced by public policy.

[22] Based on the relevant software manuals, Stover & Kirmeyer (2005 and Stover (2005)

# DemProj

The demographic model in Spectrum, known as DemProj, is a computer programme for making population projections for countries or regions. The programme requires information on the number of people by age and sex in the base year, as well as current year data and future assumptions about the TFR, the age distribution of fertility, life expectancy at birth by sex, the most appropriate model life table, and the magnitude and pattern of international migration. This information is used to project the size of the future population by age and sex for as many as 150 years into the future. If desired, and if suitable source data are available, the projection can also estimate the size of the urban and rural populations.

Linking DemProj with other modules in Spectrum makes it possible to examine the demographic impact of AIDS, the family planning service requirements to achieve demographic and health goals (FamPlan), the costs and benefits of family planning programmes and the socioeconomic impacts of high fertility and rapid population growth. DemProj was first produced in 1980. Since then, it has been used by a large number of planners and researchers around the world. It has been updated from time to time in response to comments and suggestions from users.

## Data Inputs Required by DemProj

### A. Base Year Population

The starting point for projections is the number of people in the population by age and sex in the base year. For both males and females, the population is divided into five-year age groups from 0-4 to 75-79. There is also a final age group for those people aged 80 and older.

Base year population figures are available from a number of sources. Usually, the best source will be a national census. There are other sources of population data if recent census reports are not available. The Population Division of the United Nations publishes a considerable amount of population data. The most useful sources for population projections are the *Demographic Yearbook*, which contains the most recent census data for most countries; and the *World Population Prospects,* published every two years and containing population estimates and projections for most countries of the world. *World Population Prospects* contains estimates of base year populations as well as assumptions about future levels of fertility, mortality and migration, including estimates and projections of population by five-year age groups that have been adjusted for misreporting. These data may be used when reliable census data are not available.

DemProj contains a module called EasyProj which use data from *World Population Prospects to produce national population forecasts from base year data.*

When DemProj is to be used to provide inputs to the AIM, then the base year must be sufficiently far back in history that HIV/AIDS had no impact on the population.

### B. Fertility

A population projection requires information about the level of fertility (obtained through the TFR) and about its shape (obtained through the age distribution).

#### *1. The Total Fertility Rate*

**Base Year Estimates:** The TFR is the number of live births a woman would have if she survived to age 50 and had children according to the prevailing pattern of childbearing at each age group. Estimates of the TFR are available from a number of sources. The best sources will be national fertility surveys.

**Future Assumptions:** An assumption about the future TFR is required for most population projections. Again, the best source is usually national projections or population policy goals. Alternatively, projections may be obtained from international sources such as the United Nations Development Programme (UNDP) as reported in the World Population Prospects.

### *2. The Age Distribution of Fertility*

In addition to the TFR, the age distribution of fertility is also required to make a population projection. In DemProj, this information is entered as the percentage of lifetime fertility that occurs in the five-year age groups 15-19, 20-24, 25-29, 30-34, 35-39, 40-44, and 45-49.

## C. Mortality

Mortality is described in DemProj through two assumptions: life expectancy at birth by sex, and a model life table of age-specific mortality rates.

### *1. Life Expectancy at Birth*

**Base Year Estimates**: Life expectancy at birth is the average number of years that a cohort of people would live, subject to the prevailing age-specific mortality rates. It is a useful measure that summarises in one indicator the effect of age-specific mortality patterns. Life expectancy can be calculated from vital statistics on deaths if reporting is complete. In the developing world, death registration is not usually complete enough to be used for this purpose. Estimates of life expectancy are usually derived instead from large-scale surveys or censuses. The best source of information on life expectancy will usually be national reports prepared by analysing these surveys. If national estimates are not available, life expectancy estimates may be obtained from a variety of other sources, including the United Nation's *World Population Prospects* or the *Demographic Yearbook*, the USA Census Bureau's *World Population Profile*, the *World Population Data Sheet* of the Population Reference Bureau, or the World Bank's *World Development Indicators*.

**Future Assumptions:** An assumption about future levels of life expectancy at birth is required for all population projections. There are several options for setting the life expectancy assumption. These include national projections, national population goals, United Nations and USA Census Bureau projections, or recent trends and international experience, or the United Nations model schedule.

### *2. Life Expectancy and AIDS*

In a number of countries, the AIDS epidemic has had a significant impact on mortality. It affects both life expectancy and the age and sex pattern of mortality. This health concern raises two problems for population projections. First, in countries with high HIV prevalence, the future course of the AIDS epidemic will be the single largest determinant of future life expectancy. Second, the age pattern of mortality will depart significantly from the patterns described in the model life tables discussed below.

Therefore, in countries with adult HIV prevalence greater than a few percent, it is best to consider the effects of AIDS explicitly in the population projection. These effects cannot be incorporated simply by changing the life expectancy assumption since the age pattern of mortality is also affected (AIDS-related deaths are concentrated in the age groups of 15-49). The recommended approach is to first develop a population projection that ignores the effect of AIDS, then to make assumptions about the future level of adult HIV prevalence and let the computer programme calculate the effects of AIDS on the population projection. Such projections can be prepared using DemProj and AIM, the AIDS component of Spectrum.

### *3. Age-Specific Mortality*

**Model Mortality Tables:** The mortality input to DemProj, life expectancy at birth, indicates overall mortality in a population. But Demproj also needs the pattern of mortality in order to produce mortality rates by age group. Specifically, the rates required by DemProj are survival ratios, which will survive one age group into the next five-year group.

The majority of countries to which DemProj has been applied have had no complete, empirical life tables - and life tables are what yields survival ratios, or $s_x$. Even if there were such tables, generally little is known about how the pattern of mortality would evolve, given projected changes in mortality levels. So DemProj employs model life tables: the Coale-Demeny and the United Nations tables for developing countries (United Nations, 1982). Although these two sets differ in the algorithm they use to generate the mortality schedules, and the empirical data sets from which they were drawn, they are similar in that they contain regional families that are distinguished by underlying causes of death. The applicable model life tables for a particular country can either be derived from typical regional tables (if a country is similar to others in the region) or by comparing the range of tables with actual data on key indicators such as life expectancy and crude death rates.

### D. Migration

Migration refers to the number of migrants moving into or out of the area for which the population projection is being prepared. If the projection is for a country, then it is international migration. Migration is specified through two inputs. The first is the net number of migrants, by sex and year. If the net flow is outward, then net migration should be a negative number. If the net flow is inward, then the net migration should be a positive number. In most cases, information on migration will come from local sources, usually studies based on a national census. The United Nations report *World Population Prospects* does contain estimates and projections of total net migration, but they are not disaggregated by sex.

## Projection Outputs

DemProj will calculate and display the population size by year. Projections can be examined in terms of total population or population by age, sex, and region. In addition, a number of demographic indicators can also be displayed. A complete list of indicators available is given below.

**Total population size**

**Population aged 0-4**

**Population aged 5-14**

**Population aged 15-64**

**Population aged 65+**

**Total net international migration**

**Annual Growth Rate (GR):** The rate at which the population is increasing or decreasing in a given year due to natural increase and net migration, expressed as a percentage of the base population.

**Births**: The total number of annual births.

**Child-Woman Ratio**: The number of children under the age of five per woman of childbearing age (15-49).

**Crude Birth Rate (CBR):** The number of live births per 1,000 population in a given year.

**Crude Death Rate (CDR):** The number of deaths per 1,000 population in a given year.

**Deaths:** The total number of annual deaths.

**Defined Age Group:** The size of the population in a user defined age group.

**Dependency Ratio:** The ratio of the economically dependent part of the population (those aged 0-14 and 65 and over) to the productive part (those aged 15-64).

**Doubling Time**: The number of years it would take for the population to double its current size at the current annual rate of growth.

**Gross Reproduction Rate (GRR):** The average number of daughters that would be born to a woman (or a group of women) during her lifetime if she passed through all her childbearing years conforming to the age-specific fertility rates of a given year. This is similar to the TFR except that it counts only daughters.

**Infant Mortality Rate (IMR):** The number of deaths of infants under one year of age per 1,000 live births.

**Life Expectancy [e(0)]:** The average number of years a person can expect to live based on the age-specific death rates for a given year. This is the calculated life expectancy at birth. If AIM is not being used, then this number will be the same as the input life expectancy. However, if AIM is being used, then the calculated life expectancy will include the impact of AIDS-related deaths and will be different from the input life expectancy.

**Mean Age of Childbearing:** The average age of mothers at the time of birth.

**Median Age:** The age that divides a population into two numerically equal groups.

**Net Reproduction Rate (NRR):** The average number of daughters that would be born to a woman (or a group of women) during her lifetime if she passed through all her childbearing years conforming to the age-specific fertility rates and age-specific mortality rates of a given year. This is similar to the GRR except that it includes the effect of mortality that would cause some women to die before completing their childbearing years.

**Rate of Natural Increase (RNI):** The rate at which the population is increasing or decreasing in a given year due to the surplus or deficit of births over deaths, expressed as a percentage of the base population.

**Sex Ratio:** The number of males per 100 females in a population.

**Total Fertility Rate (TFR):.** The average number of children that would be born alive to a woman (or a group of women) during her lifetime if she were to pass through all her childbearing years conforming to the age specific fertility rates of a given year.

**Under-five Mortality Rate (U5MR):** The number of deaths to children under the age of five per 1,000 live births.

## Methodology

Details of the methodology used to prepare the projections can be found in the Spectrum manual (Stover & Kirmeyer, 2005).

# AIDS Impact Module (AIM)

## Projection Inputs

AIM requires data describing the characteristics of the HIV/AIDS epidemic and the response to it. Some of these data (e.g., adult HIV prevalence) must be specific for the area being studied, whereas others (e.g., the MTCT rate) can be based either on local data or on international averages when local data are unavailable. This section describes the inputs required, possible sources and recommendations for default values when local data are not available.

### A. Demographic Projection

As noted above, AIM requires that a demographic projection first be prepared using DemProj. Two key points are relevant when preparing a DemProj projection for use with AIM:

1. For accuracy, the first year of the projection should be before the starting year of the HIV/AIDS epidemic. It is possible to start the projection in a year after the beginning of the AIDS epidemic, but this type of projection will be less accurate.

2. The life expectancy assumption entered into DemProj should be the life expectancy in the absence of AIDS. AIM will calculate the number of AIDS-related deaths and determine a new life expectancy that incorporates the impact of AIDS. It is necessary to use this two-step process because model life tables (for specifying the age distribution of mortality) do not contain patterns of mortality that reflect the excess deaths caused by AIDS.

### B. Adult HIV Prevalence

**Base Year Estimates:** Adult HIV prevalence is the percentage of adults aged 15 to 49 who are infected with HIV. Thus, this estimate of prevalence refers to the entire adult population aged 15 to 49, not just a specific risk group. The best source of prevalence data is from national Sero-Prevalence Surveys. Sentinel surveillance surveys based on pregnant women can also be used, but prevalence rates obtained from such surveys may not be representative of all adults. UNAIDS also prepares estimates of national HIV prevalence for most countries, based on careful consideration of the available surveillance data, by risk group; recent trends in HIV infection; and national population estimates. The latest estimates are available from the UNAIDS website at http://www.unaids.org.

**Future Projections:** An AIM projection requires an estimate of future levels of HIV prevalence. Usually AIM is used to illustrate the future consequences of an epidemic. Therefore, it is not necessary to try to predict future prevalence. Rather, AIM can be used with plausible projections of future prevalence to show what would happen if prevalence followed the indicated path. In this case it is only necessary to have a plausible projection.

When AIM is used to stimulate policy dialogue, it is often helpful to use a conservative projection of future prevalence. This approach will avoid charges that the presentation is using the worst possible assumptions to make the case for AIDS interventions stronger and will allow the discussion to focus on other, more important issues.

### C. Progression from HIV Infection to AIDS Death

The progression period describes the amount of time that elapses from the time a person becomes infected with HIV until he or she dies from AIDS. AIM uses the cumulative distribution of the progression period. This distribution is defined as the cumulative proportion of people infected with HIV who will die from AIDS, by the number of years since infection. For example, it might be that for

all people infected in a certain year, 1% will die within one year, 3% will die within two years, 7% within three years, etc. The incubation period can be specified for up to 20 years. The cumulative percentage dying from AIDS by year 20 will be the percentage that ever dies from AIDS. Thus, if this value is equal to 95%, it implies that 5% of people infected with HIV will never die from AIDS. AIM uses separate progression periods for adult men, adult women and children. AIM allows for "fast" and "slow" patterns of incubation.

### D. Age and Sex Distribution of Infections

To calculate HIV incidence from the prevalence input, AIM needs to have some information on the distribution of infection by age and sex. This information is provided through two editors, one for the ratio of prevalence at each age group to prevalence in the 25-29 age group, and one for the ratio of female to male prevalence.

AIM has two default patterns, one for generalised epidemics and one for low level and concentrated epidemics. Default patterns of the distribution of HIV infection by age by type of epidemic have been developed from population-based surveys and reported AIDS cases.

Where population prevalence data are available for a particular country, the observed pattern can be substituted for the default pattern in the survey year and the entire pattern over time will be adjusted to match.

### E. Mother-to-Child Transmission

The MTCT rate is the percentage of babies born to HIV-infected mothers who will be infected themselves. Studies have found that this percentage ranges from about 13% to 32% in industrialised countries and 25% to 48% in developing countries. The higher rates have generally been found in studies in Africa, where a significant amount of transmission through breastfeeding may take place, and the lower figures have been found in Western Europe. AIM uses a default value that depends on breastfeeding practices. If country-specific information is available, it can be used instead of the default values.

The probability of transmission may be changed if a country implements programmes to prevent MTCT of HIV. The effect of such programmes can be included by indicating the type of treatment used and the infant feeding options promoted. The type of programme can include treatment with Nevirapine, AZT or some other treatment, as well as infant feeding options (formula feeding, exclusive breastfeeding or mixed feeding).

### F. Total Fertility Rate Reduction

It is not clear how the TFR might be affected by an HIV/AIDS epidemic. Some women who find that they are infected with HIV may want to have as many children as possible while they can, in order to leave descendants behind. Others may decide to stop childbearing upon learning that they are HIV+ in order to avoid leaving motherless children behind. Since the majority of people do not know if they are infected or not, knowledge of HIV infection is not likely to have a large effect on the desired fertility rate.

AIDS could lead to higher age at first intercourse as the dangers of unprotected sex become known. This trend would lead to lower fertility rates. Studies of the determinants of fertility found no clear evidence but concluded that the most likely result is that an HIV epidemic will slightly reduce fertility. Two studies in Uganda found that HIV-infected women had lower fertility rates than HIV-negative women. Since most women did not know their sero-status, the reduced fertility rates were

most likely due to biological rather than behavioural factors. This finding suggests that fertility might be 20% to 50% lower among HIV-infected women.

The default value in AIM is that fertility among 15-19 year old women is 50% higher among HIV+ women than HIV-negative women and that fertility among women 20-49 is 20% lower among HIV+ women than HIV-negative women.

### G. Anti-retroviral Therapy

Anti-retroviral therapy can extend life and improve the quality of life for many people infected with HIV. ART has restored health to many people and continues to do so after many years. But ART does not help everyone. Some people have a good reaction initially but over time the virus becomes resistant to the drugs and the benefits diminish. Others experience such severe side effects that they cannot continue to take the drugs.

AIM can calculate the effects of ART based on an assumption about the proportion of those in need receiving ART. ART is assumed to delay progression to death as long as it is effective. However, some people will develop resistance to anti-retrovirals and others may have to stop treatment because of severe side effects. As a result, only a proportion of those on ART in one year continue the next year. When a person stops ART, s/he progresses to die of AIDS-related illnesses quickly.

Since people with HIV will survive longer if they are on ART, introducing anti-retrovirals will tend to raise prevalence initially as new infections continue to occur and there are fewer deaths. In most cases the prevalence input will be derived from surveillance data collected when anti-retrovirals were not available. Thus, both the prevalence input, and the resulting incidence estimate, can be considered to represent the situation without ART. In that case, and if incidence remains the same, introducing ART will raise prevalence above the input projection. However, if ART is already being supplied to significant portions of the population, the historical surveillance data and, thus, the prevalence projection input will already include the effect of ART. In this case, the prevalence estimate should not be changed by ART; instead, incidence should be adjusted downward to compensate for the life-prolonging effects of ART.

AIM determines the effect of ART on prevalence by comparing the coverage of ART in 2005 with the highest coverage level in the years after 2005. If coverage increases significantly, then prevalence will be affected by the longer survival of those on ART. If coverage is already at or near its maximum value in 2005, then prevalence after 2005 will not be affected.

### H. Orphans

AIM will estimate the number of AIDS and non-AIDS orphans caused by adult deaths. An orphan is defined as a child under the age of 18 who has lost at least one parent. These estimates are based on the time history of fertility and the age at death. AIM will estimate maternal orphans (children whose mother has died), paternal orphans (children whose father has died), and dual orphans (children whose father and mother have both died). AIDS orphans are children who have lost at least one parent to AIDS. To estimate double AIDS orphans, AIM needs to estimate the proportion of couples with both parents infected with HIV. This estimation is based on a regression equation using data from national population surveys in SSA. To make the estimate more precise, two additional pieces of information are required: the percentage of women aged 15- 19 who have not married, and the percentage of married women who are in monogamous unions. Both of these parameters are available from national population surveys for most countries.

## Projection Outputs

A complete list of the indicators calculated and displayed by AIM and their definitions is given below.

### A. Total Population

**Number Infected with HIV:** The total number of people who are alive and infected with HIV.

**HIV Age Distribution:** The number of infected people, by age and sex.

**Number of HIV+ Pregnant Women:** The number of pregnant women who are infected with HIV.

**Number of new HIV infections:** The total number of new HIV infections each year.

**Adult HIV Incidence:** The percentage of uninfected adults who become infected in each year.

**New Infections by Age:** The number of new infections by age and sex and incidence by age and sex.

**New AIDS Cases:** The number of people progressing to AIDS each year.

**AIDS Age Distribution:** The number of people alive with AIDS, by age and sex.

**AIDS-related Deaths:** The annual number of deaths due to AIDS.

**Cumulative AIDS-related Deaths:** The cumulative number of AIDS-related deaths since the beginning of the projection.

**AIDS-related Deaths by Age:** The number of AIDS-related deaths each year by age and sex.

**HIV/AIDS Summary:** A table with a selection of indicators shown for a selection of years.

### B. Adults (15-49 years old)

**HIV Population:** The total number of adults who are alive and infected with HIV.

**Adult HIV Prevalence:** The percentage of adults (population aged 15 to 49) who are infected with HIV.

**Number of New HIV Infections:** The total number of new adult HIV infections each year.

**Adult HIV Incidence:** The percentage of uninfected adults who become infected in each year.

**New AIDS Cases:** The number of adults progressing to AIDS each year.

**AIDS-related Deaths:** The annual number of adult deaths due to AIDS.

**Number Newly Needing ART:** The number of adults progressing to the stage where they need ART. This is estimated as those within two years of death from AIDS-related illnesses if they do not receive ART.

**Total Number Needing ART:** The total number of people needing ART. This includes those newly needing therapy and those who continue successfully on therapy from the previous year.

**Number on ART:** The number of people receiving ART.

**Unmet need for ART:** The number needing ART who are not receiving it.

**Adult Population:** The number of adults between the ages of 15 and 49.

**Adults 15-49 Summary:** A table showing indicators just for adults 15-49.

### C. Children (0-14 years old)

**HIV Population:** The total number of children who are alive and infected with HIV.

**Number of New HIV Infections.** The total number of new child HIV infections each year.

**New AIDS Cases:** The number of children progressing to AIDS each year.

**AIDS-related Deaths:** The annual number of child deaths due to AIDS.

**Children 0-14:** The number of children between the ages of 0 and 14 years old.

**Number of Children Needing ART:** The number of children who have progressed to moderate-to-severe disease and, therefore, need ART.

**Number Receiving ART:** The number of children receiving ART.

**Child Summary:** A table showing indicators just for children under the age of 15.

### D. AIDS Impacts

**Tuberculosis (TB) Cases:** The annual number of new TB cases.

**Young Adult (15-49) Deaths:** The total number of annual deaths occurring to adults between the ages of 15 and 49, inclusive.

### E. Orphans

**Maternal AIDS Orphans**: Children under the age of 15 who have lost their mother to AIDS.

**Paternal AIDS Orphans:** Children under the age of 15 who have lost their father to AIDS.

**Dual AIDS Orphans:** Children under the age of 15 who have lost both parents to AIDS.

**All AIDS Orphans**: Children under the age of 15 who have lost one or both parents to AIDS.

**Maternal non-AIDS Orphans**: Children under the age of 15 who have lost their mother due to causes other than AIDS.

**Paternal non-AIDS Orphans**: Children under the age of 15 who have lost their father due to causes other than AIDS.

**Dual non-AIDS Orphans:** Children under the age of 15 who have lost both their parents due to causes other than AIDS.

**All non-AIDS Orphans:** Children under the age of 15 who have lost one or both parents due to causes other than AIDS.

**Maternal Orphans**: Children under the age of 15 who have lost their mothers due to other causes.

**Paternal Orphans**: Children under the age of 15 who have lost their father due to other causes.

**Dual Orphans**: Children under the age of 15 who have lost both their parents due to other causes.

**Total Orphans**: Children under the age of 15 who have lost one or both parents due to other causes.

**Summary by Age**: A table showing orphans by type and single age.

**Summary Table**: A table showing all orphans by type and year.

# Chapter 6: An Empirical Analysis of the Link between Aid Flows, the Exchange Rate and Inflation in Uganda

## 1. Introduction

Like many low-income countries in Africa, Uganda is heavily dependent on external donor support to finance budgeted government spending. Donor funds have accounted for an average of 43% of total public expenditures over the past decade, a large portion of which is spent on non-traded goods and services. Over this period, Uganda has experienced a surge in aid inflows, reflecting the country's qualification for the Heavily Indebted Poor Countries (HIPC) debt relief initiative, and because of the need to control the daunting scale of HIV/AIDS epidemic. Uganda was one of the ten top recipients of total Official Development Assistance (ODA) flows to the health sector over the same period, and over the last five years, Uganda received over US$ 400 million of aid to the Health sector under donor project funding and US$ 496 million under the PAF budget. Uganda is also amongst the world's top ten recipients of aid earmarked for HIV/AIDS control. Between 2003/04 and 2006/07, the national HIV/AIDS budget grew dramatically, from about US$ 40 million in 2003/04 to nearly US$ 170 million in 2006/07, and is projected to rise even further. Almost all of this is provided by external donors. The USA is the main donor, as Uganda is one of the focus countries of the PEPFAR. UNAIDS and other UN Agencies which support a variety of HIV/AID activities in Uganda, as well as many other donors as detailed in Chapter 4 of this report. Projections in the Uganda AIDS Commission (UAC) National Strategic Plan for 2007/08 to 2011/12 indicate that total spending could double further, to US$ 511 million in 2011/12, and this would be largely (85%) donor funded (UAC, 2007).

Such increased resource inflows should in principle be beneficial for Uganda, as in other low-income developing countries. The additional resources can be used to assist in the treatment and prevention of HIV/AIDS (as well as other diseases) and for addressing some of the social consequences of the disease, as well as provide for the rapid replacement of human resources lost to the infection and for the training of additional personnel to address the urgent issues of prevention, treatment and mitigation.

However, the surge in aid inflows to Uganda, in particular towards HIV/AIDS programmes, is looked on with some fear by many donors and policy makers due to its possible macroeconomic consequences that may undermine growth. The concern about macroeconomic instability derives from the fact that because aid flows are (i) large relative to the economy and (ii) often volatile and sometimes politically influenced, they may have the potential to increase macroeconomic instability (i.e. inflation, exchange rates as well as interest rates). Based on the presumption that a stable macroeconomic environment is critical for growth, Uganda is committed to maintaining single digit inflation levels, low budget deficits and BoP equilibrium. Among others, there is a fear that monetary injections arising from additional aid-induced spending would lead to inflationary pressures and volatility or appreciation of the REER unless sterilised. Moreover, rapid increases in aid (even when it is sterilised) as in the case of Uganda, can lead to adjustment costs. First, the direct impact of large

aid inflows can affect the quality of aid management, coordination and public service delivery. Second, there can be indirect impacts on key markets and sectors, including the labour market, the capital goods sector and, money and foreign exchange markets. In the latter case, the volume of aid flows to government may overwhelm the capacity of the domestic authorities to avoid short-run volatility in the exchange rate and interest rates, both of which can be damaging to private sector investment. This is particularly acute in countries where financial markets are thin. The macroeconomic impact will also be larger to the extent that aid flows are spent on locally-produced goods and services (rather than imports), and especially when spent on non-traded goods and services.

The second area of concern is that receipts of foreign exchange can cause the nominal and real exchange rate to appreciate, which may in turn adversely affect exports, economic growth, diversification, employment and poverty.

These concerns also reflect the fact that various measures of Uganda's exchange rate have shown a tendency to appreciate during some periods, although in general the exchange rate has depreciated in nominal and real terms over the past decade. In particular, the REER appreciated between 1992/93 qnd 1997/98, and again in 2001/02 and 2004/05, while the Nominal Effective Exchange Rate (NEER) also appreciated in 1992/93 to 1994/95, 2001/02 and 2004/05 (see Figure 41). The appreciation of the exchange rate has led to concerns over its possible effect on the prospective competitiveness of Uganda's exports (the Dutch disease)[23], its possible long run effects on growth of the economy[24], and the reasons behind the appreciation, in particular the role played by aid inflows to Uganda which increased rapidly in particular over the last decade to support Uganda's poverty reduction programmes.[25]

While these concerns have been under debate, attempts to empirically quantify them have been inconclusive. This chapter contributes to the debates by offering some empirical evidence on two of the major sets of macroeconomic linkages from increased aid flows. First, it considers the possible impact of increased aid flows on the REER and inflation. Although the major concern for the broader study is with the effects of aid devoted to HIV/AIDS programmes, we consider the effects of total aid to the GoU, largely reflecting the nature of available data[26]. Using a Vector Autoregression (VAR) model of Uganda, and monthly data for the period July 1994 to June 2007, we examine the following: (i) The link between aid flows and inflation and (ii) The link between aid flows, inflation and the REER. The results provide some conclusions regarding the possible impacts of aid on the economy, and policy advice on whether increased aid towards welfare improvement is appropriate.

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[23] See for example, BOU/MFPED (2004).

[24] The real appreciation reduces the competitiveness of the domestic traded goods sectors. Over the long run, production in these sectors contract and resources shift to the production of non-tradables. This may lead to a less diversified and more vulnerable economy that is increasingly dependent on external resource flows.

[25] External Budget support to Uganda rose from about 3 per cent of GDP in 1999 to about 8 % of GDP in 2001, following the development of the Poverty Eradication Action Plan (PEAP) which led to the introduction of the Poverty Action Fund (PAF) in 1998/99 (Atingi Ego, 2005).

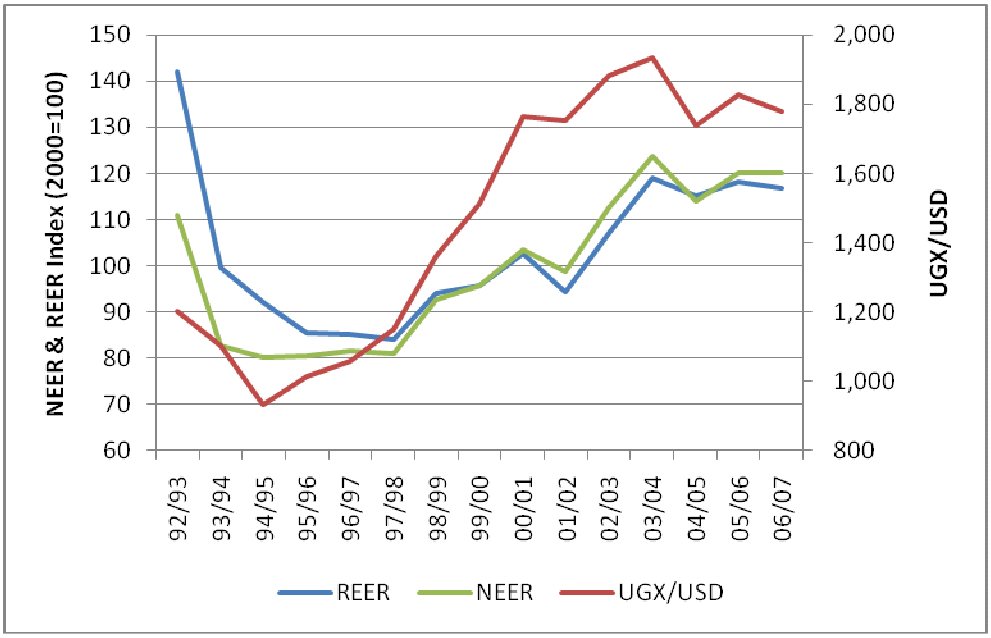
[26] While this may appear to be a potential problem with the analysis, it should not be. First, the available data for such analysis only relates to total aid, and data on the resources specifically for HIV/AIDS are not available over the time period and with the frequency (quarterly) that is required. Second, the macroeconomic effects considered here (on inflation, the exchange rate, exports etc.) result from the magnitude of the incoming financial flows rather than what they are earmarked for, so the analytical results in this chapter do not depend on the nature of the aid, just its magnitude.

Second, the chapter quantifies the relationship between the exchange rate and exports, in order to provide insights about the possibility of an aid induced Dutch disease. In particular, the study attempts to answer the following question: "What is the nature and extent of the effects of changes in REER on individual goods and services exports in Uganda?" The result could be used to gauge whether there has been an aid-induced Dutch disease effects on Uganda. It also addresses whether exchange rate volatility affects exports in Uganda, and draws out policy lessons that can be learnt from the empirical findings.

To accomplish these objectives, we estimate a model of the determinants of Ugandan exports supply over the period 1993-2006. We focus on six exports: three traditional exports (coffee, cotton and tea) and three non-traditional exports (fish, maize and flowers). The merchandise exports selected together accounted for 44% of total export receipts in 2005/06.

The rest of the chapter is structured as follows. Section 2 provides a brief literature survey on the aid-macro debates, and on the nexus of ODA, exports and exchange rates. Section 3 provides a descriptive analysis of the linkages between aid inflows, inflation and the REER, and of the trends in selected determinants of Ugandan export supply. This is followed in Section 4 by a description of the methodology and the data. The empirical findings are discussed in Section 5. Section 6 concludes and draws policy implications.

**Figure 41: Nominal and Real Effective Exchange Rates**




*Source: Bank of Uganda*

## 2. Literature Survey

### Aid Flows, Exchange Rate and Inflation

Financial inflows carry some benefits to the recipient countries. As noted by several writers (for example, Serieux, 2007), the additional resources can be used to: (i) Provide badly needed resources for the treatment and prevention of HIV/AIDS (as well as other diseases) and for addressing some of the social consequences of the disease; (ii) Provide for the rapid replacement of human resources lost to the infection and the training of additional personnel to address the urgent issues of

prevention, treatment and mitigation; (iii) Make progress towards the achievement of other MDGs; and (iv) Provide relief from savings and foreign exchange constraints, thus allowing for more optimal (and ultimately more growth-enhancing) decision making with respect to production and investment-related choices.

However, the effectiveness of large inflows of ODA requires the ability of the recipient countries' institutions and macroeconomic policies to stimulate private sector investment. Therefore, in assessing the benefits with which ODA is associated, they should be evaluated against its possible harmful side effects on the REER, prices and the adjustment costs. Various literatures point out the aid benefits-aid costs nexus.

Nkusu (2004a), for instance, argues that, conscious of the possible adverse effects of the ODA inflows on the REER, policy makers have responded by sterilising (sale of Treasury bills) excess liquidity injections arising from government spending of the ODA. But, the high domestic interest rates that sterilisation induces creates macroeconomic management problems by attracting further capital inflows especially for countries that are integrated to the global financial markets, exerting further pressures on the REER.

Indeed, in a situation where the government wishes to maintain the existing rate of growth of money supply, foreign exchange reserves and domestic credit to the private sector, the monetary expansion arising from additional aid spending would need to be sterilised by sales of foreign exchange or Treasury bills and bonds to limit aid-spending induced growth of money supply. But, the effect of aid spending also depends on how the government chooses to split its public expenditures between imports, domestically produced tradable goods and non-tradable goods and services.

Sanjeev, Powel and Yang (2005) argue that the macroeconomic impact of scaling up aid depends on how aid is spent, its composition and its assumed policy response**.** They argue that it is the interaction of the government's fiscal policy with monetary and exchange rate management that matters. If aid resources are spent directly by government on imports or if aid is spent in-kind (for example on drugs), there is no direct impact on the exchange rate, price level, or interest rates. But, if the government immediately sells to the central bank the foreign exchange it receives, then it must decide how much of the local currency counterpart to spend domestically, while the central bank must decide how much of the aid-related foreign exchange to sell on the market. In general, this would impact on the exchange rate, the price level and interest rates.

If aid resources are spent directly on domestically produced non-tradable goods and services, it will increase domestic demand, thereby inducing rising prices of the non-tradable goods and spilling over into generalised inflation, and an appreciation if not fully offset by productivity-enhancing supply side effects which are associated with higher aid flows. The extent of the effect of increased spending depends on the income elasticity of demand and price elasticity of supply in the domestic economy.

Adam and Bevan (2002) and Nkusu (2004b) note that the more elastic the supply response, the smaller the required contraction in private demand (smaller REER appreciation), while the more income elastic the demand for non-tradable goods is, the larger the appreciation of the REER could result from increased government spending. They argue that in the absence of spare capacity, the scale of the induced appreciation will depend partly on the composition of government spending and partly on the extent of substitutability in private demand. The existence of excess capacity in the tradable sector will tend to increase the appreciation, while excess capacity in the non-tradable

sector will tend to reduce it. For further discussions see, Tsikata (1999), Hansen and Tarp (2000), Collier and Dehn (2001) and Collier and Dollar (2002).

Another but less pronounced concern about the effect of rapid increases or high levels of aid flows has been volatility of aid. Aid flows are volatile for several reasons (and in several ways). First, the information content of aid commitments (the quantity generally used in recipient countries' budgeting), with respect to actual disbursements, is poor. Second, even aid disbursements themselves are more volatile than fiscal revenues. Third, aid is generally procyclical relative to revenue, meaning that it tends to exacerbate the variability in revenue streams. An implication of volatility of aid is that, in and of itself, a sharp unanticipated change in the amount of aid received by a country that is credit-rationed in international capital markets (the case for most high-aid recipients) is, effectively, an exogenous shock that imposes adjustment costs on the economy.

The marginal cost of aid (i.e. the macroeconomic distortions it imposes on the economy) is likely to rise with the rate at which the aid flow is increased. Hence, too rapid an increase in aid can reduce its effectiveness at the margin and lower the level of aid that can be absorbed before it starts to have an overall adverse impact on the economy. Adjustment-cost concerns emerge in two areas. First, through the direct impact of large aid inflows on the quality of aid management, coordination and public service delivery (so-called 'micro absorption' constraints). Second, they reflect indirect impacts via key markets and sectors:

• *The labour market*: Where the demand for labour in critical sectors can only be met through higher labour costs and lower skill levels. These pressures may occur in the public sector, both at the 'implementation' end (e.g. in the need for doctors) and at the 'coordination and management' end (e.g. in the Ministry of Health), but may also be felt elsewhere in the labour market if the public sector drives up wages or 'cherry picks' skilled workers (DFID, 2004).

• *The capital goods sector*: Where increased demand for investment in domestic assets (construction goods) caused by short-run exchange rate appreciation, raises their price and reduces the marginal efficiency of investment.

• *The money and foreign exchange markets:* Where the volume of aid flows to government may overwhelm the capacity of the domestic monetary authorities to avoid short-run volatility in the exchange rate and interest rates; both of which are damaging to private sector investment. This risk is particularly acute in countries where financial markets are thin.

As indicated by Pallage and Robe (2001), the welfare costs of the business cycles created by these shocks are particularly high in low-income countries. Further, when the pro-cyclicality of aid is added to its own cycle-inducing effects, that cost is further magnified. In cases where a cash budget is used to manage public sector spending, the stop-start-stop effect induced by the volatility of aid further compromises the effectiveness of public sector activity, with concomitant welfare and growth costs (Bulir and Hamann, 2003). In short, high aid-receiving countries face the very real prospect of greater volatility in fiscal outcomes and economic activity and reduced public sector effectiveness.

This chapter also examines the evidence of macroeconomic effects of aid in Uganda focusing on inflation and REER. The focus is on aid that is channeled through the government, as a proxy of total aid to Uganda because data on unofficial aid is not available as a continuous time series. However, it is acknowledged that currently a large proportion of the aid coming in to support the fight against HIV/AIDs, for example, aid under PEPFAR is not captured in the official aid statistics reported by government although its macroeconomic impacts would be similar to that of the official aid,

provided that the aid is spent domestically. As Report Number 3 of this project has noted, only about 40% of the aid from unofficial sources towards HIV/AIDs issues is spent domestically. This could have macroeconomic impacts (both positive and negative ones).

## Real Exchange Rate and Exports

At face value, increased external development aid for Uganda, like many other developing countries, would appear to be nothing but good news. For instance, several writers e.g. (Serieux, 2007), argue that additional resource inflows can be used to: (i) Provide badly needed resources for the treatment and prevention of HIV/AIDS as well as other diseases and for addressing some of the social consequences of the disease, such as the care of AIDS orphans and the repair and support of the challenged or compromised community institutions and household structures; and, (ii) Provide for the rapid replacement of human resources lost to the infection and the training of additional personnel to address the urgent issues of prevention, treatment and mitigation.

However, the surge in aid inflows to address the challenges of the HIV/AIDS pandemic may not be unequivocally good news, and some policy makers and donors fear its possible consequences of macroeconomic instability and/or Dutch disease effects that may undermine growth. The concern about the Dutch disease effects is that increased aid will translate into appreciation of the exchange rate and that this will damage the economy. For instance, when a country receives large inflows of foreign currency, a significant part of that aid is spent on non-tradable goods, raising their domestic prices relative to tradable goods prices. The result is a real exchange rate appreciation; which will be demonstrated mostly through a nominal appreciation in the case of a flexible exchange rate regime or a rise in domestic inflation in the case of a fixed exchange rate regime. The real appreciation reduces the competitiveness of the domestic traded goods sectors. Over the long run, production in these sectors contracts and resources shift to the production of non-tradable goods. This may lead to a less diversified and more vulnerable economy that is increasingly dependent on external resource flows. Thus, the short-run welfare benefits of the aid inflows may be superseded by the welfare losses from the increased cost of non-traded goods and the loss of production in the traded goods sector. A real exchange rate appreciation also reduces the country's potential and capacity to attract investment and grow itself out of poverty and aid dependency[27].

Many factors determine the competitiveness of a country's exports. These include, notably, the macroeconomic situation, in particular the real exchange rate in the case of a flexible exchange rate regime; the trade policy regime; the business environment; the cost and availability of credit, infrastructure; taxes; and so on.

Depreciation of the REER can raise the cost of imported products inducing increased use of local inputs and savings on imports as agents shift demand to locally produced inputs and goods, while increasing the profitability of exports. On the other hand, a REER appreciation would reduce the competitiveness of the domestic traded goods sectors as it lowers returns to entrepreneurial activity. Over the long run, production in these sectors contract and resources shift to the production of non-tradables. This may lead to a less diversified and more vulnerable economy that is increasingly dependent on external resource flows.

Empirical evidence on the effects of the REER on exports in Uganda is, however, very scanty. Atingi-Ego and Ssebudde (2000), while examining the relationship between misalignment of Uganda's REER

[27] Excellent reviews of the macroeconomic challenges imposed by the scaling up of aid flows are contained in Gupta, Powell & Young (2006) and Serieux (2006).

and non-traditional exports between 1972 and 1999 found that non-traditional exports are positively related to REER undervaluation and that overvaluation of more than 15% hurts exports. However, Nkusu (2004a) notes that while the findings of Atingi-Ego and Ssebudde (2000) could highlight important policy implications, the study could suffer from the omission of weather, which could have affected agricultural output and thus had a stronger impact on exports than the REER. Nkusu (2004a) and the Diagnostic Trade Integration Study (DTIS) (2006) also note that besides the REER, some other factors could be affecting exports, such that an appreciation on the exchange may not erode export competitiveness. First, Uganda is very likely still producing within its production possibility frontier. Unused or inefficiently used production factors, such as labour and, to some extent land, can prevent a resource transfer effect as assumed by the Dutch disease theory. There are also export (sub-sector) specific issues that affect export competitiveness. In the case of coffee, improved terms of trade during 1993/94 and1995/96 coupled with the relatively limited REER appreciation, contributed to large export volumes (Nkusu 2004a). Other factors such as export diversification and market access issues including high tariffs may also explain the trends in exports. Besides, appreciation of the REER could be due to an appreciation of the real equilibrium exchange rate arising from productivity increases, in which case there would not have been an erosion of competitiveness (DTIS, 2006 pg 18). Biggs (2007) highlights financing costs as export supply constraints in SSA countries. He notes that in most SSA countries, the relative costs of working capital credit and fixed asset financing are higher than in competitor countries. This is evidenced by high REER and high collateral requirements. Access to credit for most borrowers is also limited. Uganda firms indeed suffer from very low credit market participation and high costs of borrowing averaging 21% over the review period. The latter appears to be mainly driven by overhead costs, which in turn are a function of both wages and indirect costs including electricity and telecommunications (DTIS, 2006 pg 18). Private sector credit in Uganda is significantly lower than the averages for SSA and comparable low-income countries. Private sector credit to GDP in Uganda was 7.5% in 2004/05. This should be compared to an average of 26% for Kenya and 17% for SSA.

Turning from the relationship between REER and exports to the specific impact of aid flows, how they affect the real exchange rate and the structure of domestic production, and the size of these effects, the macroeconomic evidence is weak. Econometric estimates often show these effects to be small and statistically insignificant.[28] However, one problem is that all empirical work in this area is plagued by severe measurement problems, both of the REER itself and across alternative concepts of tradable and non-tradable goods.[29]

Yano and Nugent (1999) find mixed econometric evidence on the relationship between aid, REER, and the structure of production among a set of 44 aid-dependent countries between 1970 and1990. For Uganda, they find that although aid is associated with a depreciation of the shilling rather than appreciation during the period concerned, the non-traded goods sector expanded sufficiently as to give rise to immiserisation.

Elbadawi (1999) examined the relationship between aid, REER and non-traditional exports for a sample of 62 countries. He found that a 35% increase in aid levels was associated with a REER appreciation of 3%. However, exchange rate overvaluation was associated with an increase in non-traditional exports, rather than the contraction predicted by the Dutch disease model. This also implied a positive relationship between aid and non-traditional exports. However, that relationship

[28] For a summary of the literature see Adam (2006).

[29] Adam (2006)

was found to be nonlinear. The initial positive relationship eventually becomes negative as aid increases, exhibiting a Laffer curve effect. The implication is that aid has a positive effect on the production of tradable goods, but that effect eventually evaporates at very high levels of aid and a Dutch disease type effect takes over. Elbadawi concludes that Uganda has acute aid dependency and is likely to experience REER overvaluation.

Sekkat and Varoudakis (2000) examined one aspect of the Dutch disease story for 33 SSA countries i.e., the relationship between exchange rate overvaluation and manufacturing exports. They found a negative relationship between exchange rate overvaluation and manufacturing exports. Other authors (e.g. Rodrik, 2007) have found similar results that REER undervaluation promotes growth while an overvaluation is a major impediment to growth. However, in the absence of a corresponding link between aid and overvaluation, this does not amount to a verification of the Dutch disease story (Serieux, 2007).

Rajan and Subramanian (2005) used both the direct and indirect approaches in investigating the empirical evidence for aid-related Dutch disease. They examined the relationship between the level of aid receipts (relative to income) and the performance of exporting sectors versus sectors producing non-tradable goods. They found that in high aid-receiving countries, the exportable-producing (tradable) sectors grew significantly more slowly than the sectors producing non-tradable goods. The authors argue that the Dutch disease explanation for that effect is confirmed by the finding of a positive relationship between aid and exchange rate overvaluation and between the retarded growth of export-producing sectors (relative to non-export-producing sectors) in the face of exchange rate overvaluations. However, Serieux (2007) argues that this is not sufficient to confirm Dutch disease effects. The observed effects (aid increase, exchange rate appreciation and lower relative growth of tradable sectors) are also consistent with the condition where there is, initially, an underutilisation of capacity. Verification of Dutch disease would have to be demonstrated either by an actual contraction of the export-producing sectors or sustained and substantially slower growth sufficient to produce a considerable imbalance in the economy over the long run.

The issue of whether increased budget support to finance Uganda's poverty reduction has resulted in a Dutch disease has been a subject of much discussion. Neither the behaviour of exchange rates and performance of exports, nor data of financial flows and macroeconomic performance in general give any clear cut evidence on the issue.

Nkusu (2004b) argues that the fears for aid-induced Dutch disease in Uganda may be unfounded. During the period 1992/93 and 1995/96, there was, on an annual average basis, an appreciation of REER of 7.5%, while the terms of trade improved by 16.6% and total financial inflows increased by 24.3%. Between 1996/97 and 2000/01, the REER depreciated by an annual average of 1%, while the terms of trade deteriorated by 8% and total financial inflows increased by almost 3%. She argues that growing financial inflows, developments in terms of trade and structural reforms that the economy has undergone, indicate that the behaviour of the REER cannot be ascribed to movements in financial inflows only. Since there has neither been a significant appreciation in Uganda's REER nor a decline in real exports, despite massive financial inflows, Nkusu (2004b) concludes that the applicability of the core Dutch disease model to Uganda has been weak. She specifically advances three factors that explain the observed weak applicability of the prediction of the core Dutch disease for Uganda. First, some characteristics of the Ugandan economy depart from key assumptions of the Dutch disease model, i.e., Uganda is very likely still producing within its production possibility frontier. Unused or inefficiently used production factors, such as labour and, to some extent land,

can prevent a resource transfer effect as assumed by the Dutch disease theory. Second, economic reforms aimed at liberalising the economy in general and trade system in particular have encouraged both exports and imports and widened the trade balance. The increase in foreign inflows compensated for the shortfall in exports proceeds emanating from the adverse terms of trade shock that has affected Uganda since 1998/99. And finally, prudent monetary and exchange rate management have achieved price stability and has controlled real exchange rate appreciation.

However, she acknowledges that there is a limit to the level of aid that can be managed, beyond which it could exceed the sterilisation capacity of the monetary authorities and render macroeconomic management difficult and even undermine the growth prospects. Developments since the period considered may be an illustration of this, with even larger aid inflows. Atingi-Ego (2005) notes that more recent appreciation pressures should at least be partly attributed to the strong sterilisation effects on account of a shilling injections resulting from the donor flow to finance government fiscal deficits.

In recent years, simulation models calibrated by data have been used to understand the dynamic responses and assess the quantitative significance of the macroeconomic effects of aid flows.

Adams and Bevan (2003) develop a Computable General Equilibrium (CGE) model of aid and public expenditure where public infrastructure capital generates inter-temporal productivity spillover for both tradable and non-tradable sectors. The model also provides for a learning-by-doing externality, through which total factor productivity in the tradable sector is an increasing function of past export volumes. The model is calibrated to contemporary conditions in Uganda to simulate the effect of increased aid. They find that public expenditures whose productivity effects are skewed towards the non-tradable sector deliver the highest growth in exports and total output. The bias in productivity effects increases the supply of non-tradable goods, which is sufficiently strong to almost entirely offset the demand effects of increased aid flows. The results also show that exchange rate appreciation is reduced or even reversed enhancing export sector performance. However, in terms of poverty reduction, the results show that income gains largely accrue to urban skilled and unskilled households leaving the rural poor relatively worse off.

In a discussion paper, Atingi-Ego (2005) comments on the studies by Nkusu (2004) and Adam and Bevan (2003), that both point to the fact that the fears for a Dutch disease in Uganda may be unfounded. Whereas he acknowledges the Nkusu argument - that if there is excess capacity (which could be the case in Uganda), then an increase in aid will only move the economy closer to the production possibility frontier - he is more skeptical to the assumptions encompassed in the Adam-Bevan (2003) model. First, for the productivity spill-over effects to counteract the appreciation tendency, the price elasticity of supply must be elastic, i.e. larger than one. This is most likely not the case in Uganda, at least in the short run. Second, he questions the extent of these spill-over effects. Uganda lacks institutions to ensure efficiency of the investments, i.e. value for money. Atingi-Ego claims that even if Dutch disease exists in Uganda, the impact cannot be distinguished. Since exports and non-traditional exports in particular, are increasing, there are probably certain sub-sectors in the export sector that could be realising productivity efficiencies to be able to offset appreciating export rates.

Examining the trends in the price indices for the major components of GDP, Atingi-Ego finds that prices for non-traded goods in Uganda have grown much faster than prices for traded goods, exactly as Dutch disease theory would predict. This implies a shift of price incentives away from the production of traded goods towards non-traded goods in the last few years on account of the

increased demand for non-traded goods arising from increased government expenditures. Given the fixed supply of these goods in the short-run, price increases have been the inevitable. It is also possible that the aid-funded fiscal expansion has contributed to the increase in the trade deficit from 7.2% of GDP in 1997/98 to 10.1% of GDP in 2003/04. A shift in relative prices from tradable to non-tradable goods might also undermine the national objective of creating a dynamic export-led economy. Private sector–led export promotion is central to the Medium Term Competitiveness Strategy (MTCS) and this objective should not be compromised by an excessive fiscal deficit.

A joint study carried out by the Ministry of Finance, Planning and Economic Development (MFPED) and the BoU in (2005) to investigate the impact of the exchange rate appreciation observed during 2003/04 on competitiveness of the export sector found general negative consequences of the appreciation on some exports namely: (i) Reduction in export profitability (and even large losses in some sectors) and/ or reduction in farm gate prices, with reduced incentives having major implications for future production and value addition; (ii) Reduced export competitiveness and loss of major contracts to foreign competitors; and (iii) Reduced investment in the export sector. The paper demonstrates that the appreciation of the shilling that has occurred in recent years has adversely affected exporter profitability and export competitiveness and may have contributed to an increase in poverty, and that "Uganda's large aid-financed fiscal deficit is not necessarily compatible with the objectives of poverty reduction and strong export-led growth, even though its purpose is to finance expenditures aimed at poverty reduction" (MoFPED-BoU, 2005, p.37).

Atingi-Ego (2005) notes that these short-term consequences also have significant longer-term implications for the wider economy in that a permanently appreciated REER will discourage export diversification and export-led growth in general, in addition to shifting incentives towards the non-tradable sector and encouraging imports. Lower farm-gate prices also reduce rural incomes and thus reduce demand for locally manufactured goods and services. The increase in poverty between 2000 and 2003 is partly attributed to falling farm-gate prices of several export crops and coincides with a slowdown in formal manufacturing growth.

Other macroeconomic consequences of aid observed in Uganda include: (i) High fiscal deficits; (ii) High domestic interest costs arising out of sales of Treasury bills to sterilise shilling liquidity injections from aid induced government spending; and (iii) High real and nominal interest rates.

Alongside the REER, exchange rate volatility, which most often is salient in flexible exchange rate regimes, can hurt exports. Friedman (1953) and Johnson (1969), however, argue that flexible exchange rates could be beneficial to the economy as they promote trade and overall macroeconomic stability. Other researchers have maintained that short-run fluctuations in exchange rates have no effects on trade. For instance, Bailey, Talvas and Ulan (1987) point out that traders anticipate future exchange rate movements better than the average exchange rate participant and gains from this knowledge could offset the risk of exchange rate uncertainty. But, Bailey *et al* continue, if the exchange rate volatility is due to fundamentals, efforts by authorities to reduce volatility by means of controls or other restrictions on trade could be more harmful to trade and could reduce it.

Some researchers, for instance, Kihangire *et al* (2005), Mundell (2000), Doroodian (1999) and Krugman (1989) argue that because of market imperfections, particularly in developing countries, hedging against exchange rate volatility is both imperfect and very costly as a basis for avoiding exchange rate risk. Therefore, exports may be negatively affected by exchange rate volatility. Kihangire *et al* (2005) highlight several reasons that explain why exports can be affected by exchange

rate volatility: (i) Most export contracts in Uganda are priced and paid for in foreign currency, therefore exchange rate variability affect export earnings valued in domestic currency. (ii) Export contracts may involve long time lags due to production delays, delivery lags and the actual settlement date, all of which may increase the extent of uncertainty. (iii) Imperfections regarding hedging facilities may make it difficult to fully anticipate and contain uncertainty caused by exchange rate variability and the extent of export product diversification and market power determine a firm's ability to suffer or export the risk. Kihangire *et al* (2005) in an investigation of the effects of exchange rate volatility on flower exports between 1994 and 2001 found that a negative relationship between exchange rate volatility and exports of flowers existed.

Overall, the evidence on the determinants on export competitiveness in Uganda is inconclusive and requires further empirical investigation especially in view of the observed appreciating REER in the recent past and its possible effects on the economy. Besides, export (sub-sector) specific issues that affect export competitiveness underscore the need to investigate (sub-sector) specific determinants of exports. This study examines six exports: coffee, tea, cotton, fish, maize and flowers.

# 3. Descriptive Analysis

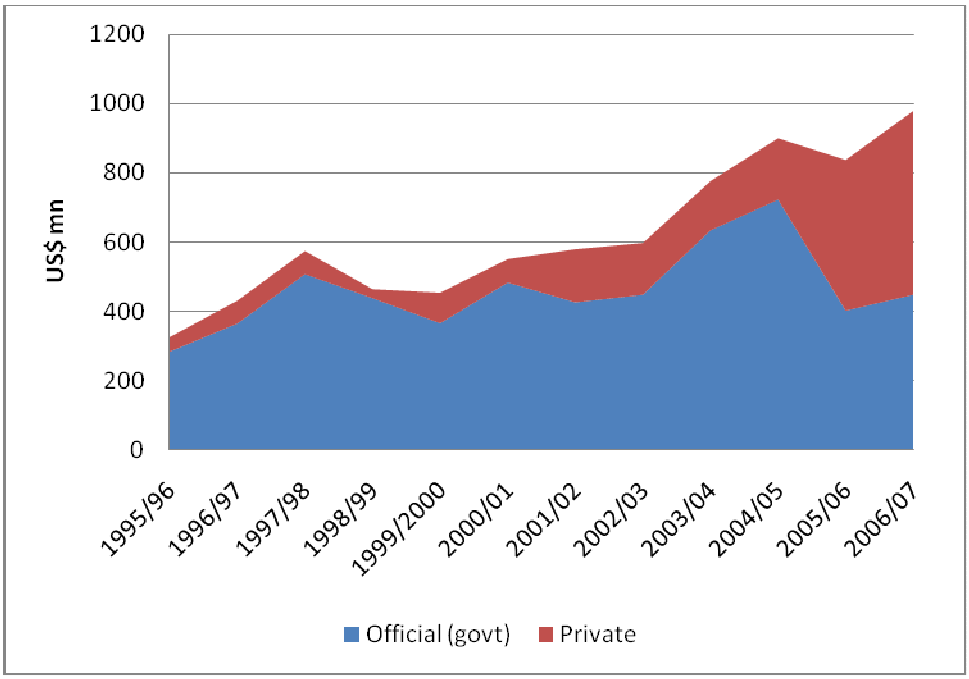
Macroeconomic stability, coupled with continued GoU commitment to reforms and increased confidence among external donors, has attracted a wave of increased official and private aid flows to Uganda. Over the last decade, official aid transfers (grants to government) averaged close to US$ 500 million per year, or 7% of GDP. In recent years, private aid transfers (to non-government recipients) have risen sharply, to comprise more than 50% of total aid receipts in 2005/06 and 2006/07 (see Figure 42). Atingi-Ego (2005) notes that the increase was as a result of the development of the first PEAP in 1997/98, which led to the introduction of the PAF in 1998/99 and the eventual qualification of Uganda for the HIPC initiative in 1998/99. Much of the official donor inflows have been spent on poverty reduction programmes including health, and primary education, water and sanitation, whose share in the PAF averaged about 77% over the decade. The share of the Health sector in PAF averaged 17%. In addition the health sector has been receiving increasing amounts of aid, mainly as project funding towards the fight against HIV/AIDS. The share of the Health sector in donor projects, for instance, averaged about 18% over the last five years. The share of total aid flows (to both government and non-government recipients) related to HIV/AIDS has been relatively small, but is rising sharply, from an estimated 4% in 2003/04 to 16% in 2006/07.

Aid has enabled the country to continue growing at an impressive rate, improvements in social welfare and, thus, a reduction in poverty. Over the last decade, GDP averaged about 6%, while the level of poverty declined from 44% in 1997/98 to 31% in 2005/06. Interventions[30] in the fight against HIV/AIDS have led to a reduction in prevalence from a peak of 18% in 1992 to the current figure of 6%.

Whereas the surge in aid inflows carries good news regarding prospects for improving welfare in the country, it has raised a number of macroeconomic concerns ranging from fears about its possible effects on REER and export competitiveness, inflation, fiscal performance and debt sustainability (for non-grant components of aid). This chapter focuses on the first two effects: real exchange rates and inflation.

[30] Interventions included information, education and communication (IEC), laboratory and blood transfusion services, sexually transmitted diseases management, care and support.

**Figure 42: External Aid Transfers (Grants) to Uganda, 1995/06 - 2006/07**



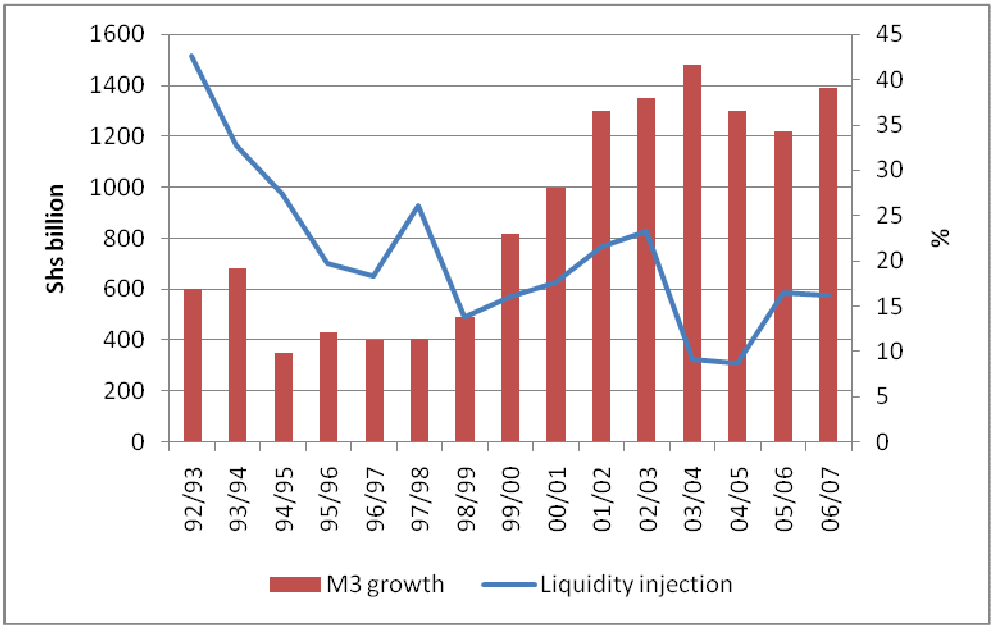

*Source: Bank of Uganda*

## Liquidity Injection[31] and Money Growth

One major concern about the surge in aid inflows is that aid-induced spending by government tends to increase money supply in the domestic economy. However, as Figure 43 indicates, liquidity injections caused by government expenditure were not always associated with increases in money supply, except for the period 1998/99 to 2002/03. On the one hand, liquidity injections may not necessarily have translated into inflationary and REER appreciation pressures basing on a number of factors: first, prudent monetary policy, which enabled liquidity injections to be sterilised; second, a large part of aid was used for government imports mainly for projects. Government project imports averaged US$ 106.52 million, compared to non-project government imports, which averaged US$ 36.44 million over the period 1993/94 to 2006/07. Further, as noted in Chapter 4 of this report, about 60% of aid towards supporting HIV/AIDs was spent externally, mainly on the importation of drugs. Third, spare capacity such as unused land, labour, and capital in the economy means that any increased government spending on domestically produced non-tradable goods can be met by adequate supply response, which in turn neutralises the Dutch disease effect. On the other hand, it is plausible to think that liquidity injections could have led to volatility in money supply, which could lead to volatility in prices and exchange rates in the short run, since anyway, injections are sterilised by the monetary authorities with a lag. Moreover, aid may impose other costs such as high domestic debt service burden and crowding out of private sector investment. This study empirically complements these arguments in order to draw a firm conclusion regarding possible movements in the REER and inflation that may be caused by aid.

[31] Calculated as total government domestic expenditure less total domestic revenues.

**Figure 43: Liquidity Injection and Money Supply Growth**




*Source: Bank of Uganda*

## Sterilisation and its Costs

The main instrument used to sterilise the liquidity injections arising from aid spending by the monetary authorities was sales of government securities (Treasury bills and bonds). Total holdings of securities by the private sector stood at Shs 2,293.4 billion in June 2007 up from Shs 50.03 billion in June 1999. The associated interest cost to government was Shs 181.1 billion in June 2007, up from Shs 1.6 billion in June 1999 (Table 24). High domestic interest costs to the government would put pressure on the fiscal balance excluding grants, and raise concerns about medium-term fiscal sustainability and domestic debt sustainability, especially in a shallow financial market. The fiscal deficit as a percentage of GDP rose from 6% in 1997/98 to a peak of 13% in 2001/02; although it improved to 9% in 2006/07, it remained higher than the level of 6% recorded in 1997/98. Besides, a crowding out of banks lending to the private sector and hence private investment, can result from sale of Treasury bills and bonds since commercial banks would find it risk free and more profitable to invest in those securities than lend to the private sector. The relatively high Treasury bills rates in the region has also attracted portfolio investment inflows in the domestic money markets exerting nominal appreciation pressures on the exchange rates.

**Table 24: Government Securities and Interest Costs (billion shillings) (as at June)**

| (June) | Face Value | Cost | Total Interest | Interest cost (%) of total security holding |
|---|---|---|---|---|
| 1999 | 50.03 | 48.48 | 1.55 | 3.09 |
| 2000 | 81.41 | 76.91 | 4.50 | 5.53 |
| 2001 | 68.10 | 62.69 | 5.41 | 7.95 |
| 2002 | 115.54 | 107.63 | 7.91 | 6.85 |
| 2003 | 131.53 | 114.44 | 17.08 | 12.99 |
| 2004 | 169.56 | 156.71 | 26.05 | 15.36 |
| 2005 | 83.88 | 76.19 | 9.69 | 11.55 |

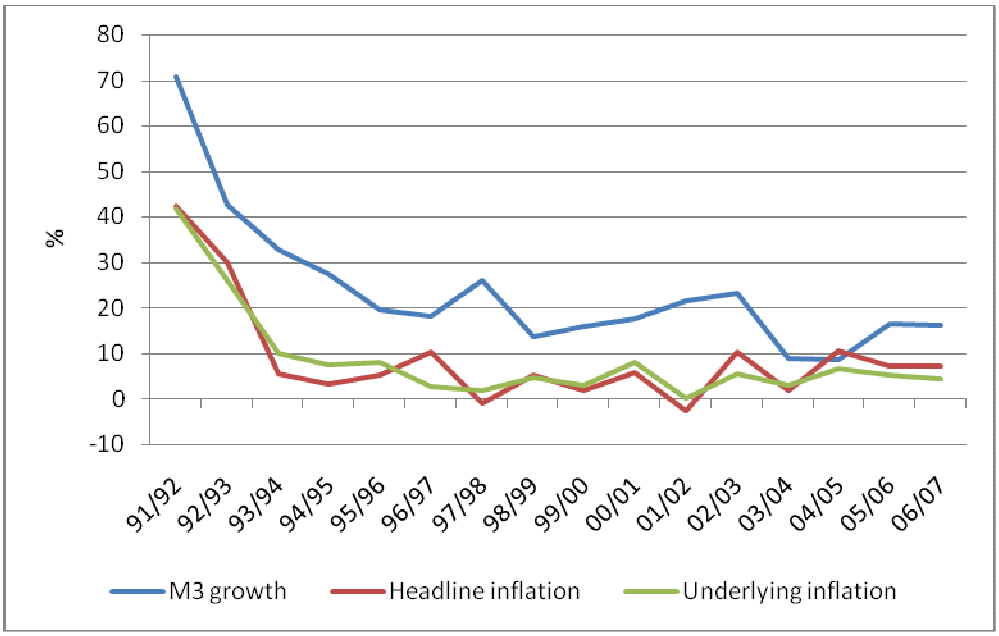
| | | | | |
|---|---|---|---|---|
| 2006 | 1,845.92[32] | 1,695.50 | 150.43 | 8.15 |
| 2007 | 2,293.43 | 2,112.31 | 181.12 | 7.90 |

*Source: Bank of Uganda*

## Broad Money (M3) Growth and Inflation in Uganda

Overall, broad money (M3) growth indicated considerable decline together with headline inflation rates over the period under review, although the relationship between money and underlying inflation is less clear, particularly over the last decade. Although there were indications of counter-cyclical relationships during 2001/02 and 2004/05, overall, there seemed to be a positive relationship between broad money growth and headline inflation in Uganda.

**Figure 44: Inflation and Broad Money (M3) Growth in Uganda**




*Source: Bank of Uganda*

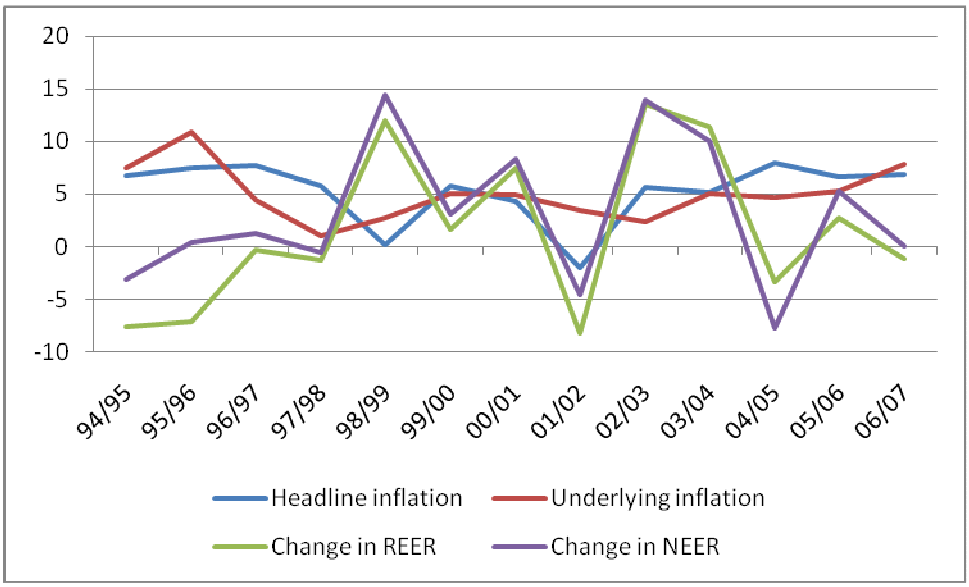
## Inflation and Real Effective Exchange Rates

Higher inflation would be expected to cause the REER to appreciate (decrease), unless offset by rising inflation in trading partner countries or a depreciation (increase) in the nominal exchange rate. As noted in Figure 45, changes in the REER were primarily driven by changes in the NEER rather than inflation; NEER depreciation was generally sufficient to offset higher inflation and cause the REER to depreciate even when inflation was rising. Only in a few instances (e.g. in 2004/05 and 2006/07 was there a combination of rising inflation and nominal appreciation that caused the REER to appreciate.

Overall, this descriptive analysis is not conclusive regarding aid-induced effects on inflation and REER.

[32] The drastic rise in Treasury bill/bond sales observed in 2006 to Shs 1,846 billion from Shs 84 billion in 2005 was caused by the need to sterilise excess liquidity that resulted from positive developments in the balance of payments, which increased the demand for Shillings.

**Figure 45: Nominal and Real Effective Exchange Rates and Inflation (annual averages)**




*Source: Bank of Uganda*

## Real Effective Exchange Rate and Export Receipts

Figure 47 through to Figure 53 indicate the movements in the REER and/or terms of trade (TOT), and total export receipts in values as well as volumes of coffee, cotton, tea, fish, maize and flowers, which together accounted for 44% of Uganda's export receipts in 2005/06 (see Table 25). The three agricultural export crops i.e. coffee, cotton, and tea—analysed in this study made up around 20% of Uganda's merchandise export receipts in 2005/06, and were the main sources of income for around 17% of the population in 2004/05 (DTIS, 2006). Of these three, coffee is by far the most important, contributing around 17% of the total merchandise export revenues in 2005/06, and being the main source of income for 11% of the population. This is followed by tea (2.5%) and cotton (1%) of merchandise exports. While coffee exports had fallen significantly from the peak reached in the mid-1990s, cotton and tea exports had been fluctuating around an upward trend, although their share in total export revenues declined to 1,2% and 2.5% in 2005/06 from 6.4% and 5.9%, respectively in 2003/04.

The differing performances of these three sub-sectors reflect, in part, differing trends in their international prices. Although coffee prices have been rising in the last four years, they are still way below the peaks reached in the mid-1990s, while cotton and tea prices have been fluctuating around a relatively flat trend over the last decade. More importantly, they reflect crop-specific issues, which if addressed would increase their production and exports even in the context of long-term declines in international commodity prices (DTIS, 2006).

Fish exports have grown rapidly over the last decade to become the largest merchandise export item in 2005/06, with an 18.5% share. The fish sector is very important for poverty reduction: it is the main source of income for some 266,000 households, equivalent to around 1.2 million people or 4% of the population. Maize is another non-traditional export, which is particularly important for regional trade. It accounted for about 2% of total export revenues in 2005/06. Flower exports, whose major destination is the European Union (EU) increased in importance over the last decade,

with their contribution to total export earnings rising from 1.5% in 1997/98 to 3% in 2005/06. The increasing importance of floriculture is reflected in the fact that the sector employs about 6,000 people (DTIS, 2006).

**Table 25: Selected Exports Receipts (million US$)**

| | Coffee | Cotton | Tea | Fish | Maize | Flowers | Sub-total | Total exports | % of total exports |
|---|---|---|---|---|---|---|---|---|---|
| 92/93 | 111.3 | 5.3 | 10.0 | 4.4 | 7.9 | 0.0 | 139.0 | 172.7 | 80.4 |
| 93/94 | 180.0 | 4.3 | 12.1 | 11.1 | 14.0 | 0.0 | 221.5 | 264.7 | 83.7 |
| 94/95 | 456.6 | 3.3 | 9.4 | 17.0 | 20.1 | 2.0 | 508.5 | 593.0 | 85.8 |
| 95/96 | 404.4 | 13.3 | 10.0 | 37.6 | 9.4 | 5.4 | 480.0 | 585.5 | 82.0 |
| 96/97 | 365.6 | 28.6 | 21.3 | 34.6 | 16.5 | 5.3 | 472.0 | 682.7 | 69.1 |
| 97/98 | 268.9 | 11.4 | 35.0 | 28.0 | 8.1 | 6.8 | 358.2 | 458.4 | 78.1 |
| 98/99 | 306.7 | 10.8 | 22.7 | 47.6 | 5.9 | 7.2 | 400.9 | 549.1 | 73.0 |
| 99/00 | 186.9 | 22.5 | 31.9 | 24.8 | 4.0 | 8.3 | 278.3 | 459.9 | 60.5 |
| 00/01 | 109.6 | 14.1 | 35.9 | 66.6 | 6.1 | 13.2 | 245.7 | 458.3 | 53.6 |
| 01/02 | 85.3 | 18.0 | 26.9 | 107.5 | 13.1 | 15.9 | 266.6 | 474.0 | 56.2 |
| 02/03 | 105.5 | 16.9 | 29.5 | 111.4 | 8.2 | 17.0 | 288.4 | 508.5 | 56.7 |
| 03/04 | 114.1 | 42.8 | 39.3 | 118.1 | 18.8 | 27.2 | 360.3 | 670.9 | 53.7 |
| 04/05 | 144.5 | 41.3 | 33.1 | 169.6 | 13.3 | 31.7 | 433.6 | 886.3 | 48.9 |
| 05/06 | 173.4 | 12.9 | 25.6 | 192.8 | 23.7 | 32.7 | 461.0 | 1,042.5 | 44.2 |

*Source: Bank of Uganda*

**Table 26: Share of Total Exports**

| | Coffee | Cotton | Tea | Fish | Maize | Flowers | Total |
|---|---|---|---|---|---|---|---|
| 1992/93 | 64.4 | 3.1 | 5.8 | 2.6 | 4.6 | 0.0 | 80.4 |
| 1993/94 | 68.0 | 1.6 | 4.6 | 4.2 | 5.3 | 0.0 | 83.7 |
| 1994/95 | 77.0 | 0.6 | 1.6 | 2.9 | 3.4 | 0.3 | 85.8 |
| 1995/96 | 69.1 | 2.3 | 1.7 | 6.4 | 1.6 | 0.9 | 82.0 |
| 1996/97 | 53.6 | 4.2 | 3.1 | 5.1 | 2.4 | 0.8 | 69.1 |
| 1997/98 | 58.7 | 2.5 | 7.6 | 6.1 | 1.8 | 1.5 | 78.1 |
| 1998/99 | 55.9 | 2.0 | 4.1 | 8.7 | 1.1 | 1.3 | 73.0 |
| 1999/00 | 40.6 | 4.9 | 6.9 | 5.4 | 0.9 | 1.8 | 60.5 |
| 2000/01 | 23.9 | 3.1 | 7.8 | 14.5 | 1.3 | 2.9 | 53.6 |
| 2001/02 | 18.0 | 3.8 | 5.7 | 22.7 | 2.8 | 3.4 | 56.2 |
| 2002/03 | 20.7 | 3.3 | 5.8 | 21.9 | 1.6 | 3.4 | 56.7 |
| 2003/04 | 17.0 | 6.4 | 5.9 | 17.6 | 2.8 | 4.0 | 53.7 |
| 2004/05 | 16.3 | 4.7 | 3.7 | 19.1 | 1.5 | 3.6 | 48.9 |
| 2005/06 | 16.6 | 1.2 | 2.5 | 18.5 | 2.3 | 3.1 | 44.2 |

*Source: Bank of Uganda*

It is observed that the REER had an impact on Uganda's exports during some periods, but the relationship seems the opposite of what would be expected in other periods, and varied across different exports. Figure 46 shows that between the periods 1992/93 and 1996/97, while the REER appreciated steadily, export receipts increased rapidly, probably on account of the 1993/94 coffee boom as a result of the rise in international coffee price and the subsequent TOT improvement. However, between 1997/98 and 2000/01, although the REER depreciated, export receipts exhibited both periods of decreases and increases, suggesting a mixed REER influence on exports. Between 2002/03 and 2006/07, a sharp increase in the total export receipts was preceded by a depreciation of the REER. However, total export receipts seemed to have moved in line with TOT (see Figure 47). For example, the sharp improvement in TOT of the mid 1990s, which was due to the rise in

international prices of coffee, was followed by a sharp increase in export receipts. Deterioration in TOT in the late 1990s and early 2000s was followed by a fall in export receipts. In the past three years, when TOT showed an improvement in export receipts.

**Figure 46: Evolution of the REER and Total Export Receipts**

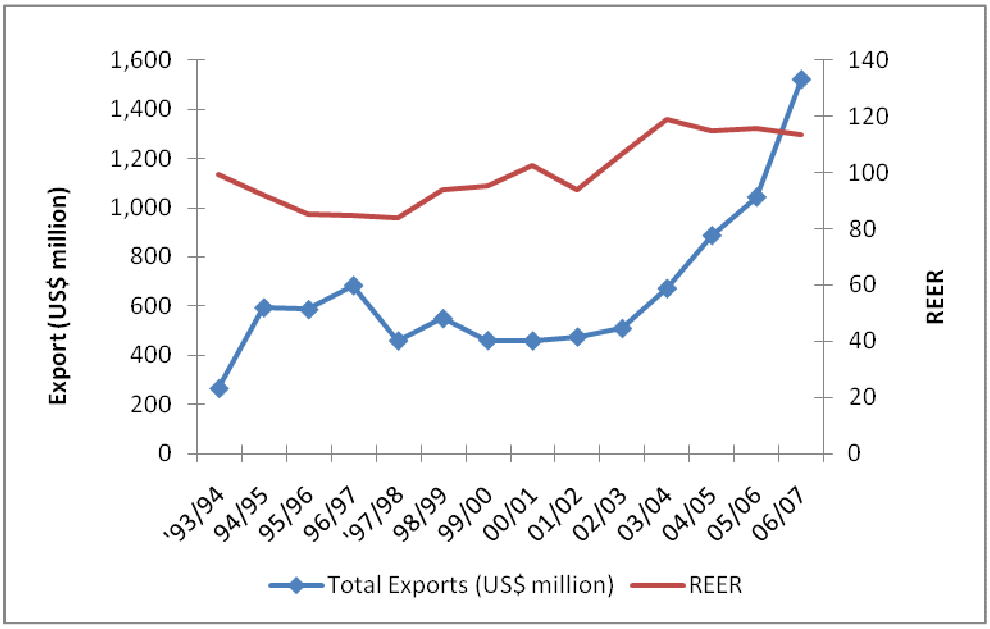
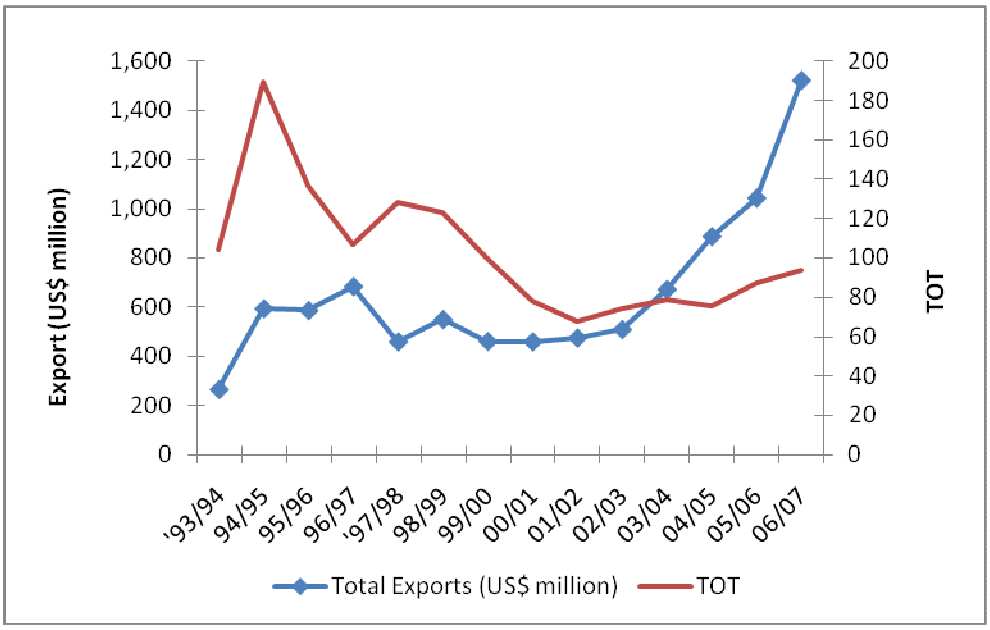



**Figure 47: Total Exports (US$ mn) and Terms of Trade**




Examination of the relationship between the REER and specific exports further confirms the inconsistent relationship between the REER and exports and also reveals that the relationship varied by type of exports (see Figure 48 through to Figure 53). In the case of coffee (Figure 48), a sharp rise in export volumes is noted during the period 1995/96 to 1997/98, when the REER was appreciating. This could mainly be explained by a rise in the international prices of coffee during that time. For much of the last five years, however, coffee exports have been declining although the REER was either rising or relatively constant. As noted by the DTIS (2006), the main issue with coffee is the

coffee wilt disease (CWD), which has affected more than half of the robusta trees (over 80% of Uganda's coffee is robusta). The loss due to CWD is around 44% of the estimated 2005/06 output, and around one-quarter of recent export revenues. Figure 49 and Figure 51 indicate that tea and fish moved fairly in line with the REER over the periods 1997/98 to 2004/05 and 1999/2000 to 2004/05, respectively. Cotton and maize showed the most contrasting relationships between export volumes and the REER over the review period (see Figure 50 Figure 52). However, fish and flower exports moved quite in line with the REER over the review period (see Figure 51 and Figure 53).

This analysis not only points to the fact that the relationship between the REER and exports might be weak for some exports and uneven across different exports in Uganda, but also that there could be other factors (besides the REER) affecting exports. Nkusu (2004) for example noted that Uganda being a predominantly agricultural country, adverse weather conditions that had affected the country repeatedly could have had a more stronger impact on exports than even the REER and TOT shocks. Deininger and Okidi (2001) counted weather and diseases among the common determinants of changes in yields for many crops in Uganda between the period 1992 and 1999.

**Figure 48: Coffee Exports (volume) and REER**

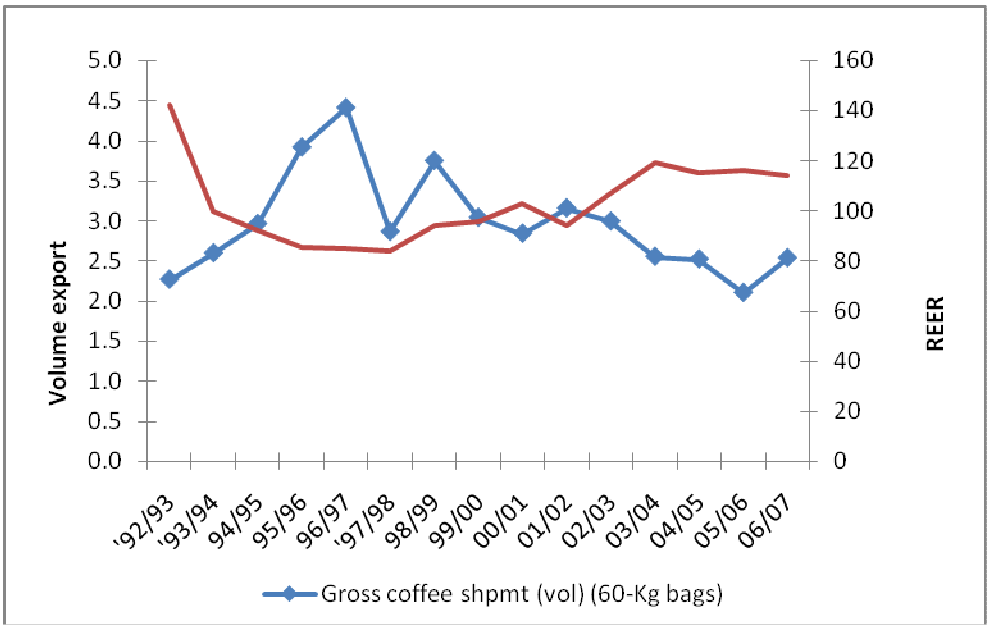


**Figure 49: Tea Exports (volume) and REER**

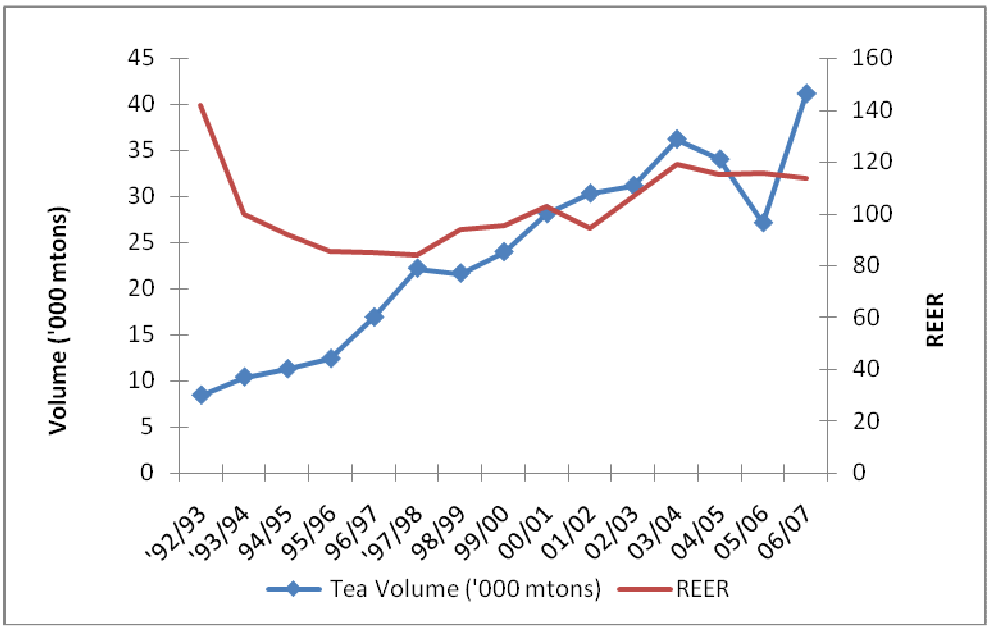



**Figure 50: Cotton Exports (volume) and REER**

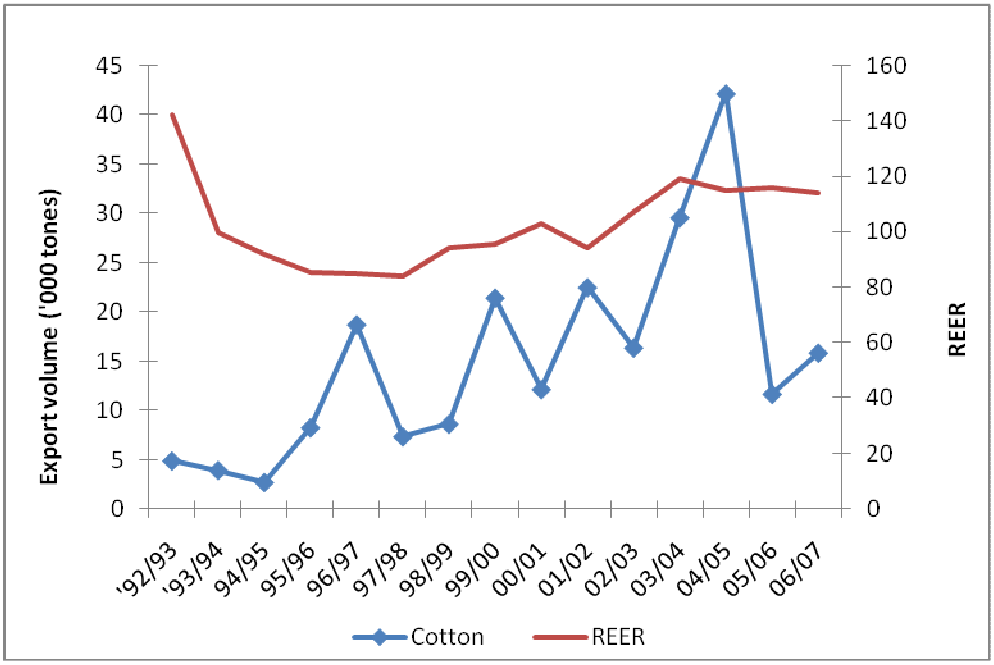


**Figure 51: Fish Exports (volume) and REER**

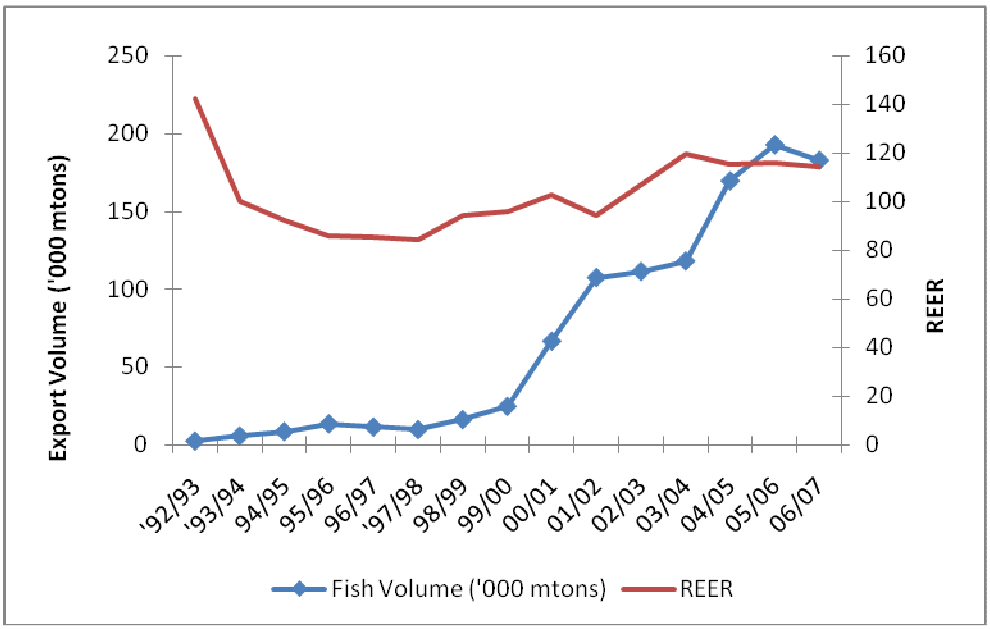



**Figure 52: Maize Exports (volume) and REER**

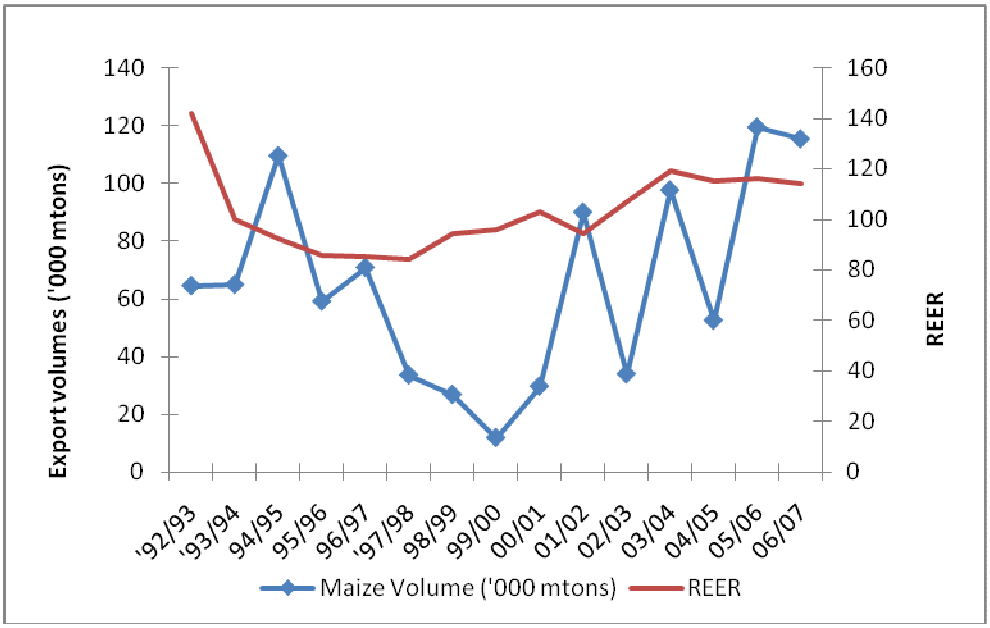
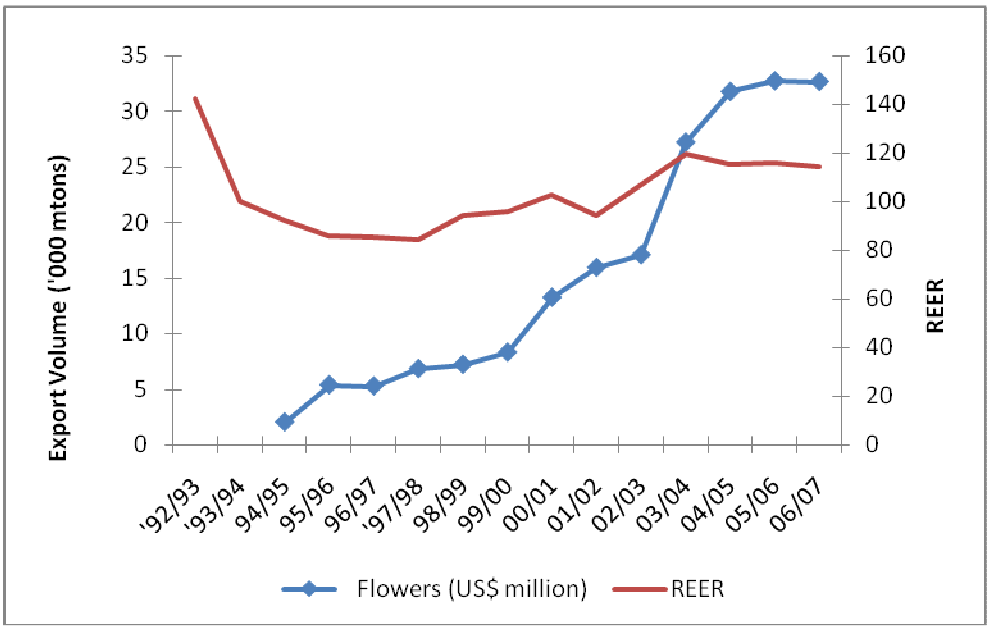


**Figure 53: Flower Exports (value, US$ million) and REER**




## 4. Estimation Methods and Data

Two different models are estimated in this chapter: one which links aid flows, inflation and the REER, and another which links the REER and exports. Details of the models are given at Appendix 1. The first uses a Vector Autoregressive (VAR) analysis to derive the responses of REER and inflation to aid flows. The second comprises an export supply model that assumes supply side constraints as the major factors affecting exports, including the REER, costs and availability of working capital.

The data used in the empirical analysis of aid, inflation and the real exchange rate is a monthly time series, which covers the period July 1994 to June 2007. All data series are transformed to logarithmic form. The series on macroeconomic variables, i.e. aid (FTA), REER, money supply (BM3) and prices were obtained from quarterly and annual reports published by BoU. We use two measures of prices; underlying and headline consumer price index (CPI). Underlying CPI excludes food prices while headline CPI includes prices of all items. Money supply (BM3) includes both shilling and foreign currency deposits. The trade weighted REER rebased (100=2000) were obtained from the BoU database. The REER for Uganda is computed as the NEER index adjusted for relative movements in national prices and its trading partners. A decrease in the REER implies an appreciation whereas an increase implies depreciation[33].

For the export model, quarterly data for the period 1993:Q3 to 2006:Q4 is used. All data series except export unit prices and the lending rate are transformed to logarithmic form and are seasonally adjusted unless otherwise stated. The NEER (Shs/US$) and trade weighted REER rebased (2000 = 100) were obtained from the BoU database. The REER is computed as above. Exports in million 60-kg bags of coffee and in thousand metric tonnes of tea, tobacco, fish and maize and their unit prices in US$ per kilogram were obtained from the BoU database. The value, rather than the volume, of flower exports is used because data on the price of flowers is not available on continuous basis. The selection of commodity exports was based on their contributions to total export volume.

[33] For further details on the computation of the REER see Appendix Table 8.

The total contribution of all the exports studied was 44% in 2005/06. Rainfall figures are measured in millimetres and were obtained from Statistical Abstracts published by the UBOS. The cost of capital $L_{xt}$ is the quarterly average lending rate. Exchange rate volatility (VAVB) is computed as a quarterly average of volatility obtained from a GARCH (1, 1) model for the monthly nominal exchange rate series (NER).

# 5. Estimation Results

## Identifying the Effects of Aid

The VAR results (provided in detail in Appendix 2) show that aid flows have an impact on the money supply but not on inflation, perhaps reflecting that due to sterilisation measures of liquidity by the monetary authorities, injections of liquidity into the economy following government expenditure would not be inflationary, though they would lead to short run increases in money supply. This is further reflected by the fact that money supply growth does not cause higher prices. However, both aid and money are associated with changes in the REER implying a possible aid induced effect on the REER, although conclusions cannot be established at this level until we examine the impulse response functions.

The next step therefore captures the responses of the money supply, CPI and REER to an increase in aid using impulse response functions. Figure 54 and Figure 55 display the responses of the other variables in the system to shocks to aid, money supply, CPI and the REER, over a horizon of 12 months following a shock, using headline and underlying inflation, respectively.

Focusing on column 1 of Figure 54 which indicates the response of the macroeconomic variables to shocks to aid, it can be seen that changes in aid are associated with volatility in all the other variables: money supply (column 1, figure 2), CPIH (column 1, figure 3) and REER (column 1, figure 4). Specifically a one standard shock to aid would be followed by an initial increase in money supply of 0.05 standard deviations after about 1 month, and then followed by fluctuations up and down in money supply within 0.05 – 0.1 standard deviations. The fluctuations of prices (up and down) to a change in aid start at about the fourth month with 0.15 standard deviations. They are always negative and do not exceed 0.15 standard deviations. The last figure in column 1 indicates that an increase in aid leads to volatility in the REER over the next year. In about the second month following a 1 standard deviation increase in aid, the REER depreciates by about 0.05 standard deviations, it then fluctuates down and up over the coming periods within a range of 0.05 to – 0.075 standard deviations. However, although these findings indicate that aid would lead to macroeconomic instability through volatility in prices and REER, the impact is very small.

Consistent with the results in Figure 54, the second last figure of column 2 shows that money supply hardly causes any changes in prices, until after one year. This could be explained by the fact that injections of liquidity brought about by government expenditure would be sterilised through monetary policy (for instance through sales of Treasury bills). The last figure in column 2 indicates that an increase in money supply which could result from government expenditure would be associated with both depreciations and appreciations (volatility) of the REER starting with depreciation in the second to fifth month. The magnitudes of the changes are very small. The last figure in column 3 indicates that changes in prices are associated with very small increases in the REER starting in the first month, and later smaller decreases in the REER starting in the sixth month. Alhough these results would indicate possible macroeconomic distortions caused by aid on the economy via volatility in key prices (inflation and REER), the impact is very small.

Similar results are obtained when the underlying CPI is used, with the exception that the rise in underlying CPI starts early in the second month following an increase of aid. Underlying CPI then starts falling after the forth month; thereafter the effect disappears (see the second last chart, column 2 of Figure 55).

This study specifically finds that although aid may have an adverse impact on the economy through causing short-run volatility in prices and REER, the impact is small. This could be explained by the fact that there are measures by the monetary authorities to sterilise liquidity injections arising from aid. However, volatility in the REER may be damaging to private sector investment as it would lead to temporary losses to exporters. Indeed, two studies on the Uganda economy found that exchange rate volatility discouraged the export of some goods (see Kihangire *et al,* 2005; Nannyonjo and Apaa, 2007). Moreover, aid dependence could also distort institutional development; in this case through high transaction costs by requiring substantial resources to be allocated to the coordination and management of aid flows, particularly in an economy like Uganda where financial markets are thin. As Table 24 indicates, management of aid by the monetary authorities was associated with interest costs of the Treasury bills averaging 8% of the total stock of Treasury bills over much of the review period. High domestic interest costs to the government would put pressure on the fiscal balance excluding grants and carry negative implications for medium-term fiscal and domestic debt sustainability, especially in a shallow financial market. Moreover, the fact that the largest proportion of government securities is held by the commercial banking sector could lead to crowding out of private sector development.

## Real Exchange Rate and Exports

The results of the modeling exercise[34] indicate that the REER affects some Uganda exports, in line with the predictions of economic theory that a depreciation or appreciation of the REER would encourage or discourage production of exports, in particular fish, flowers and cotton. The other variables that affect exports are unit prices/TOT, rainfall and the lending rate although the effect varies by type of export.

Table 27 and Tables A7-A13 (Appendix 2) indicate that the main factors affecting total exports in Uganda are TOT and volatility of the exchange rate. The coefficient on the TOT variable is positive and significant, indicating that an improvement in TOT would encourage exports. Specifically a 1% improvement in TOT would lead to an increase in exports receipts of 0.6%. Though the coefficient on VAVB is significantly positive, it is not consistent with the fact that exchange volatility would create a risky business environment that would discourage exports. We do not establish a significant relationship between the REER and total exports. However, this was not the case for all the individual export commodities as explained below:

Table A8 indicates that exports of coffee are mainly affected by rainfall and the cost of capital. In particular, a 1% increase in rainfall leads to a 0.8% increase in coffee exports. An increase in the lending rate of 1% reduces coffee exports by 0.6%.

Table A9 indicates that tea exports mainly adjust to deviations from long run equilibrium. This implies that any shock to tea export production that drifts it away from its long run path would not last for a long period of time.

[34] An error correction model was used. See Appendix 2 for detailed results.

Table A10 indicates that cotton exports are affected by the REER, although the effect is very small. In particular, an increase in the REER (depreciation) is associated with an increase of 0.04% in exports. The exports of cotton are also negatively affected by their past values.

Table A11 indicates that a depreciation of the exchange rate leads to a 2.7% increase in fish exports. This finding would support the view that an appreciation of the REER would hurt export competitiveness. It would also have negative implications for poverty reduction, given that fish is a rapidly growing export (constituting one of the largest merchandise export item) and being the main source of income for some 266,000 households, equivalent to around 1.2 million people or 4% of the population. This finding supports the earlier findings by Atingi-Ego and Ssebudde (2000). Finally, fish export is negatively related to its past values.

Table A12 indicates that the main factors affecting maize export are rainfall and its past values. The coefficients on rainfall and maize past values are positive and statistically significant. Specifically, a 1% increase in rainfall would help increase maize export supply by 0.5%.

Table A13 indicates that the main factors affecting flower exports are the REER and cost of capital. Specifically, a 1% increase in the REER would help increase supply of flower export by 3%. An increase in the cost of capital by 1% would lead to a fall in flower exports by 1.5%. Rainfall and time (technological change) also affected the export of flowers. More rainfall discouraged the supply of flowers. In particular, a 1% increase in rainfall reduced supply of flower exports by 0.3%. Flower exports were also positively affected by developments that occurred over the review period as reflected by a positive and statistically significant coefficient on the time trend variable.

**Table 27: Responsiveness of Exports to 1% Change in Independent Variable**

| Exports | Terms of Trade (ToT) | Real Exchange Rate (REER) | Rainfall | Exchange rate volatility | Interest rate |
|---|---|---|---|---|---|
| Total Exports | 0.6 | .. | .. | .. | .. |
| Coffee | .. | .. | 0.8 | .. | -0.6 |
| Tea | .. | .. | .. | .. | .. |
| Cotton | .. | 0.04 | .. | .. | .. |
| Fish | .. | 2.7 | .. | .. | .. |
| Maize | .. | .. | 0.5 | .. | .. |
| Flowers | .. | 2.89 | -0.33 | .. | -1.5 |

.. no effect or not significant

*Source: Appendix 2, Tables A7-A13*

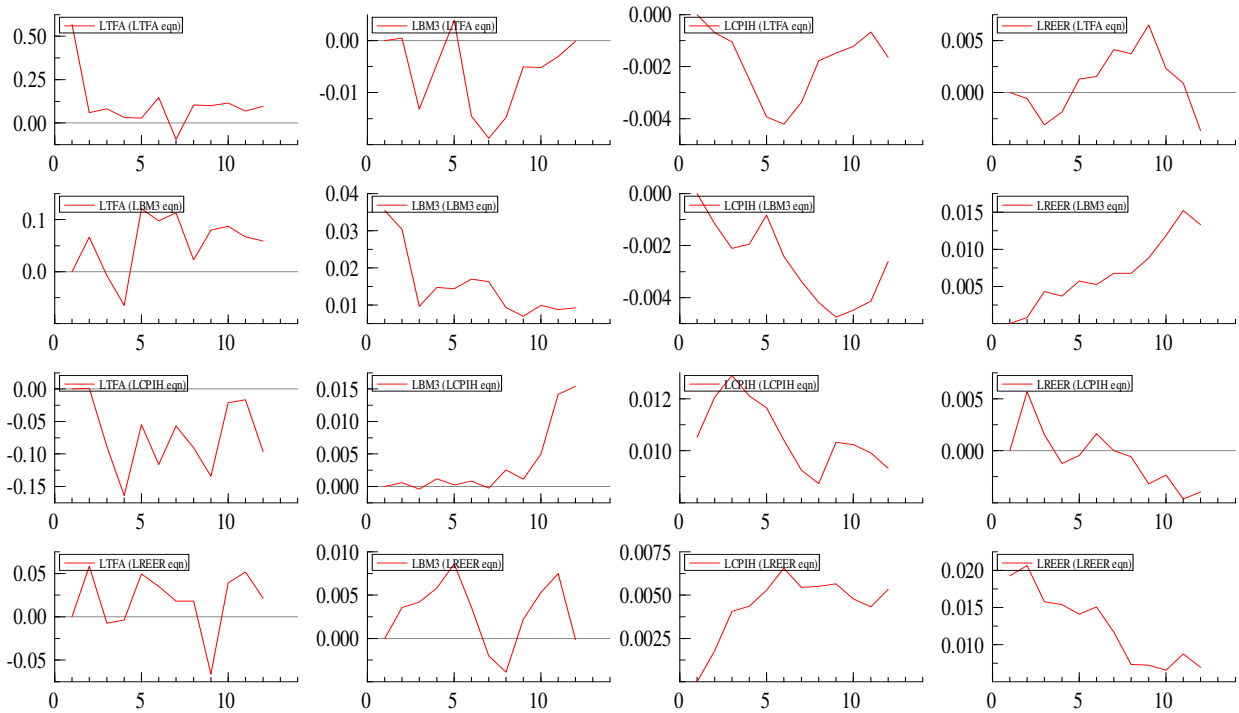
# 6. Conclusions and Policy Recommendations

This chapter analyses the impact of aid flows to the Ugandan economy on prices and REER over the period July 1994 – June 2007, using a VAR. It finds that an increase in aid flows is associated with a long-term increase in the money supply, as expected. However, this does not lead to any long-term increase in prices or to REER appreciation, which suggests that the BOU's monetary policy and sterilisation strategy has been successful. In the short run, an increase in aid is associated with greater volatility in both prices and the REER, although the impact is small. Volatility in the REER could be damaging to private sector investment. Moreover, aid dependence leads to high interest costs by requiring substantial resources to be allocated to the management of aid flows by the

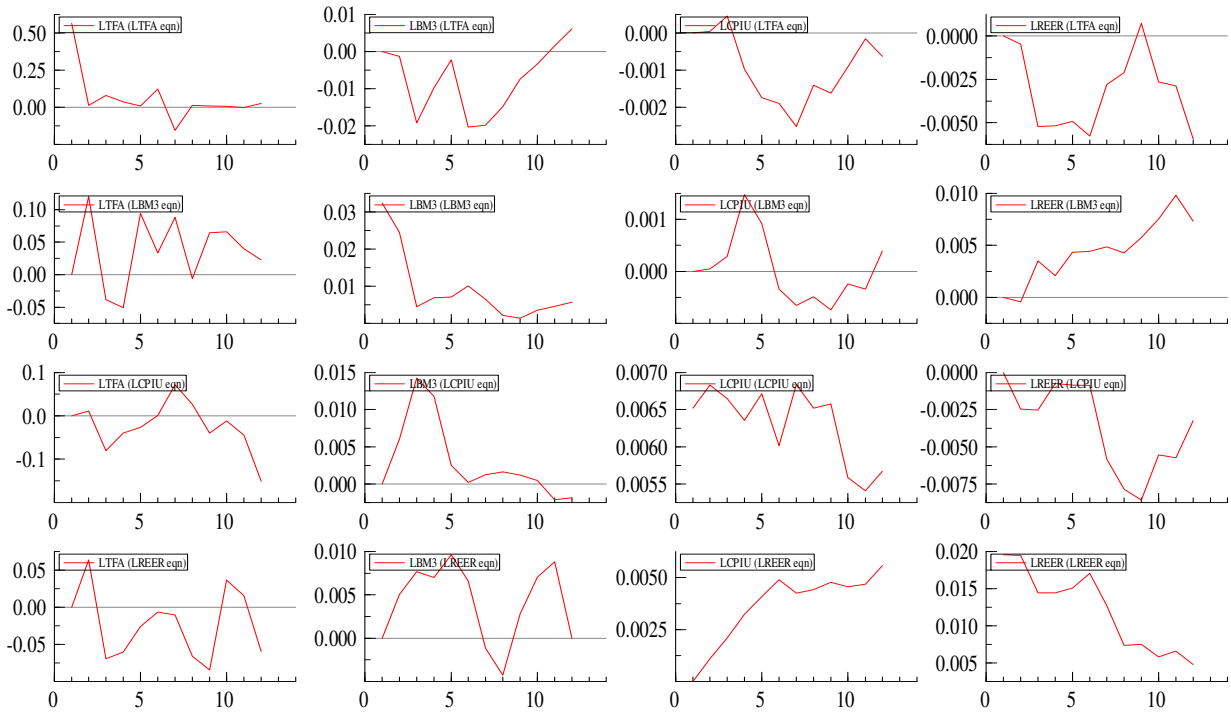
monetary authorities. This would have negative implications for medium-term fiscal sustainability and domestic debt sustainability.

The chapter also attempts to quantify the relationship between the REER and exports in order to provide insights about the possibility of an aid induced Dutch disease effect on the Ugandan economy that could partly be caused by aid towards the control of HIV/AIDS. To accomplish this objective, a model of determinants of six Ugandan exports (coffee, tea, cotton, fish, maize and flowers) is estimated using vector error correction analysis and quarterly data over the period 1993-2006. The results indicate that the REER would affect specific exports, namely, fish, flowers and cotton, which together account for nearly a quarter of Uganda's exports. Thus, for fish, flowers and cotton, the findings indicate a possible Dutch disease effect; although firm conclusions cannot be made unless the study is complemented by an examination of the link between aid and the REER. This is an issue that is left for future research. Moreover, the study could have benefited from including additional explanatory variables, which are likely to constrain Uganda's exports, including infrastructure such as electricity, road network, among others. To the extent that a possible Dutch disease effect would reduce supply of some exports, poverty reduction efforts in the long run would be negatively affected given that a significant proportion of the rural households are dependent on these export commodities. This underscores the need to contain appreciation pressures that may arise from aid flows, which have played a big role in Uganda's poverty reduction programmes over the last decade, in particular control of HIV/AIDS. Finally, the findings indicate that weather (rainfall), unit prices/TOT, and cost of capital also affect Uganda's exports although to varying degrees depending on the type of export.

**Figure 54: Identifying the Effects of Aid using Headline Inflation**



## Figure 55: Identifying the Effects of Aid using Underlying Inflation



# Appendices

## Appendix 1: Models and Estimation Methods

### Aid flows, inflation and the real exchange rate

Vector Autoregressive analysis is used to derive the responses of REER and inflation to aid flows. Assume that aid affects inflation and REER via money supply. Let the time path of inflation (CPI), REER and money supply (BM3) be affected by current and past realisations of the aid (*F*) sequence. The transmission of aid to the economy can be represented by the following structural model:

$$M_t = \alpha_{M+}\beta_{MM} M_t + \beta_{MF} F_t + A_M(L)X_t + \upsilon_{Mt}$$
$$F_t = \alpha_F + \beta_{FM} M_t + \beta_{FF} F_t + A_F(L)X_t + \upsilon_{Ft} \qquad (1)$$

where $\alpha_M$ and $\alpha_F$ are vectors of intercept terms; $M_t$ is a vector of macroeconomic variables (including REER, prices and money supply); $F_t$ is a vector containing aid variables; $\beta_{ij}$ are matrices of impact multipliers;[35] $A_M(L)$ and $A_F(L)$ are *k*th-order matrices of structural polynomials in the lag operator *L* (such that $B(L) = B_1L + B_2L^2 + \ldots + B_kL^k$); $X_t = [M_t' \; F_t']'$; and $\upsilon_{Mt}$ and $\upsilon_{Ft}$ are vectors of structural (orthogonal) disturbances. The first equation in (1) describes the behavioural relationships between $M_t$ and all variables in the VAR model, including the aid variables $F_t$. The second equation in (1) describes the relationship between the aid variables ($F_t$) and the macroeconomic variables.

In order to estimate the system, it must be transformed into a usable form, or the VAR in standard form:

$$M_t = A_M + B_M(L)X_t + e_{Mt}$$
$$F_t = A_F + B_F(L)X_t + e_{Ft} \qquad (2)$$

where $A_M$ and $A_F$ are vectors of intercept terms; $B_M(L)$ and $B_F(L)$ are *k*th-order matrix of polynomials in the lag operator *L*; and $e_{Mt}$ and $e_{Ft}$ are vectors of structural disturbances. It is assumed that $e_{Mt}$ and $e_{Ft}$ are serially uncorrelated with constant variances.

Since the right hand side of the equations in (2) contains only predetermined variables and these are by definition not correlated with the error terms (assuming no serial correlation), consistent estimates can be obtained from each equation using Ordinary Least Squares (OLS). However, estimating the VAR requires an appropriate lag length to be determined. This is done by imposing cross-equation restrictions that reduce the number of lags. Although a likelihood ratio test would be applicable to any type of cross-equation restriction, it is based on asymptotic theory, which limits its usefulness in estimations with small samples (see Enders, 1995; 1996). Likelihood ratio tests are hence supplemented by multivariate generalisations of the Akaike Information Criterion (AIC) and Schwartz Bayesian Criterion (SBC).

[35] The diagonal elements of $\beta_{MM}$ and $\beta_{FF}$ are zero.

The equations in 2 are used to test for causality between variables; namely, a standard F-test is used to check if all the coefficients on the lagged values of a variable included in an equation are jointly significantly different from zero. A further test is the block causality test, which determines whether lags of one variable Granger-cause any other variable in the system. Implementing this test involves restricting all lags of the variable in all the equations of the other variables to be equal to zero.

To further study the interrelationships among the variables in the system, we use impulse response functions, which capture the dynamic responses of the variables contained in ($X_t$) to the set of structural shocks ($\upsilon_{Mt}$ and $\upsilon_{Ft}$). These are obtained by inverting the VAR, yielding its Vector Moving Average (VMA) representation, such that the variables included in the VAR are expressed in terms of the current and past values of the *n* types of shocks:

$$X_t = \overline{X} + \sum_{i=0}^{\infty} \theta_i \upsilon_{t-i} \qquad (3)$$

By plotting the coefficients of $\theta_{jk}(i)$ against *i* we can, for instance, trace the response of the

where $\overline{X} = [\overline{M}_t, \overline{F}_t]$ is the unconditional mean of $X_t$, $n$ is the total number of variables in the system and $\theta_i$ is an $(nxn)$ matrix with elements $\theta_{jk}(i)$ representing impulse response functions. $\upsilon_t$ is an $n$ variate white noise innovation process of $X_t$, such that if $t \neq s$, $\upsilon_t$ and $\upsilon_s$ are uncorrelated.

macroeconomic variables $M_t$ (REER, inflation and money supply) to flows in aid ( $F_t$).

However, in order to identify the impulse responses, it is necessary to identify the structural form of the model from the estimated standard VAR in equation 2. A convenient Vector Moving Average (VMA) representation is one with orthogonalised innovations since they are uncorrelated both across time and across equations, hence the economic analysis can be done separately on each equation. To accomplish orthogonalisation, we use the Choleski decomposition of the covariance matrix of the VAR model, suggested by Sims (1980); that is, all the elements above the principal diagonal of the covariance matrix are restricted to zero. This implies an ordering of the variables in the system such that shocks to each variable contemporaneously affect variables ordered after it but not before it. With this assumption, the parameters of the structural VAR can be obtained using the OLS estimates of the standard VAR.

The ordering of the variables is, in this case, done such that variables that we expect to have more predictive value for other variables are first, for example aid ($F_t$). However, we take into consideration the fact that, when there is substantial correlation among innovations in variables, the decomposition of one-step variance depends strongly on the order of factorisation.

### Export Supply Equation

Borrowing from Biggs (2007), we develop an export supply model that assumes supply side constraints as the major factors affecting exports, including the REER, costs and availability of working capital. Thus, the long-run equilibrium supply constrains equation is of the following form:

$$X_t = \alpha_0 + \alpha_1 (REER_t) + \alpha_2 (P_{xt}) + z_t \quad (1)$$

where $X_t$ denotes the logarithm of export supply (volume or value), $REER_t$ is the logarithm of the real effective exchange rate, $P_{xt}$ is logarithm of export unit price of exports or TOT in case the export

equation includes total exports), $z_t$ is a disturbance term. It is expected that if the *REER* decreases, the supply of exports will fall[36], so $\alpha_1$ is expected to be negative. An improvement in the unit price $P_{xt}$ (or TOT in the case of total exports) will lead to an increase in the supply of exports, thus $\alpha_2$ is expected to be positive.

In addition, a number of factors that could affect the supply of exports are included in the short run specification:

(i) A measure of VAVB. Since exchange rate volatility creates a risky business environment in which there are uncertainties about future profits and payments for exporters, the coefficient on VAVB is expected to be negative.

(ii) Rainfall is added to measure the effect of weather on exports. The expected sign on the rainfall coefficient is positive.

(iii) Credit to the agricultural sector (total credit in the case of total exports) $crg_t$ and/or the lending rate, $L_{xt}$. More availability of credit to the sector should promote supply of exports, while a higher cost of capital would discourage exports.

To establish the long-run equilibrium relationship among the above variables, we assume equation (1) to be the cointegrating equation, which is estimated using the Johansen methodology. In the case where no cointegration is established a short run model is estimated.

$$\Delta X_t = \alpha(L)\Delta X_{t-1} + \beta(L)\Delta F_t^* + \sum_{i=1}^{4}\psi_i Z_{t-1}^i \quad (2)$$

where $Z_t = X_t - \xi' F_t$; $F_t = (1, Y_t, REER_t, v(h)_t)$; $F_t^* = (Y_t, REER_t, v(h)_t)$; $\alpha(L)$ and $\beta(L)$ are lag polynomials and the vector $\xi$ is the vector of estimated parameters from equation (1). The parameter $\psi$ is the error correction coefficient.

## Estimating Exchange Rate Volatility

As most empirical analysis incorporates a proxy for exchange rate volatility, this could be a source of inconsistencies of the effect of exchange rate volatility on exports. Some of the previous research (Kihangire et al, 2005) use a moving average standard deviation of the past monthly exchange rates, while others (Merton (1980), Klaassen (1999) and Baum *et al* (1999) use daily spot exchange rates to compute one month ahead exchange rate volatility. This study uses the GARCH model developed by Engle, (1982) and Bollerslev (1986) to quantify exchange rate volatility, based on the monthly nominal exchange rate. Let the $u_t$ be the error term of an AR (|1,4|) model of the nominal exchange rate. Now let the error process be such that:

$$u_t = v_t\sqrt{h_t} \quad (3)$$

where $\sigma_v^2 = 1$

The GARCH model is specified as the conditional variance of $u_t$ such that:

$$h_t^2 = V(u_t \mid \Omega_{t-1}) = \alpha_0 + \sum_{i=1}^{q}\alpha_i u_{t-i}^2 + \sum_{i=1}^{p}\phi_i h_{t-1} + \delta' w_t \quad (4)$$

[36] See appendix 8, footnote 8: Methodology for the computation of the NEER and REER for Uganda.

Where $h_t^2$ is the conditional error variance of $u_t$ with respect to the information set $\Omega_{t-1}$, and $w_t$ is a vector of predetermined variables assumed to influence the conditional error variances in addition to the past squared errors, while $\sum_{i=1}^{q} \alpha_i u_{t-i}^2$ and $+ \sum_{i=1}^{p} \phi_i h_{t-1}$ are the moving average (MA) and the autoregressive (AR) parts of the model.

## Appendix 2: Results

### Stationarity Test Results – Export Equation

The paper uses Augmented Dickey Fuller (ADF) approach to test whether the series are stationery either in levels or in first difference. The lag length is determined using both the Akaike information criterion and Bayesian information criteria. The test results are presented in Appendix Table 2. Except for maize, rainfall (Rain) unit price of cotton (UnitCot), and value of flowers which are *I*(0), all the variables are integrated of order one i.e. *I*(1), implying that they must be differenced once in order to make them stationary.

As discussed in Engle and Granger (1987), a linear combination of two or more non-stationary series can be stationary. If a stationary linear combination exists, then the non-stationary series are said to be cointegrated. The stationary linear combination is the cointegrating equation and can be interpreted as a long-run equilibrium relationship among the variables. The presence of a cointegrating relationship would form the basis for vector error correction estimation. Therefore, the next step in the analysis is to test for the long-run relationships among the variables in equation (1) using the methodology developed in Johansen (1991, 1995a). Cointegration was done by estimating an unrestricted reduced form VAR in levels, including the relevant export variable and its unit price, and REER. In addition, an unrestricted constant was included. The results of the cointegration estimations are shown in Appendix Tables 3-7. With the exception of tea, which shows two cointegrating relationships, no cointegration is found between the REER and the other exports. Since maize and flowers are stationary, no cointegration tests were performed on them.

**Table A1: Augmented Dicker Fuller (ADF): HO: Variable has a unit root**

The critical values used in the ADF test are -2.915 and -3.552 at 5% and 1%, respectively.

| Variable | t- ADF | t-ADF 1st diff | Order of integration |
|---|---|---|---|
| Log XVALUE | -1.591 | -5.156** | *I*(1) |
| Log(coffee) | -2.160 | -12.2211** | *I*(1) |
| Log(fish) | -2.362 | -8.5151** | *I*(1) |
| Log(REER) | -2.638 | -7.3085** | *I*(1) |
| Log(tea) | -1.92 | -7.9098** | *I*(1) |
| Log(NER) | -1.14 | -3.405* | *I*(1) |
| Log(cotton) | -1.728 | -10.51** | *I*(1) |
| Log(maize) | -3.598** | -8.0920** | *I*(0) |
| Log (TOT) | -2.061 | -7.649** | *I*(1) |
| Log(Rain) | -5.641** | | *I*(0) |
| Log (Flowers) | -2.104 | -5.695** | *I*(1) |
| Log Credit Agric | 0.062 | -6.518** | *I*(1) |
| Log Total Credit | -1.471 | -5.827** | *I*(1) |
| Lending rate (LRB) | -2.444 | -6.479** | *I*(1) |
| Unit price-coffee | -2.061 | -6.301** | *I*(1) |
| Unit price-tea | -2.186 | -8.329** | *I*(1) |
| Unit price-fish | -1.322 | -7.343** | *I*(1) |
| Unit price-maize | -1.78 | -9.838** | *I*(1) |
| Unit price-cotton | -3.295* | | *I(0)* |

**Note:** **, * means reject the null at the critical values of 1% and 5%, respectively

## Cointegration Analysis

**Table A2: Total Exports (lxvalue)**

I(1) cointegration analysis, 1994 (3) to 2006 (4)

| eigenvalue | loglik for rank | |
|---|---|---|
| | 151.0369 | 0 |
| 0.29584 | 159.8056 | 1 |
| 0.14848 | 163.8238 | 2 |
| 0.044048 | 164.9500 | 3 |

| H0:rank<= | Trace test [ Prob] |
|---|---|
| 0 | 27.826 [0.084] |
| 1 | 10.289 [0.264] |
| 2 | 2.2524 [0.133] |

Asymptotic p-values based on: Unrestricted constant
Unrestricted variables:
[0] = Constant
Number of lags used in the analysis: 4

beta (scaled on diagonal; cointegrating vectors in columns)

| | | | |
|---|---|---|---|
| LXVALUE | 1.0000 | 0.32644 | 0.47996 |
| LTOT | -1.7906 | 1.0000 | 0.17902 |
| LREER | -4.2356 | -0.15714 | 1.0000 |

alpha

| | | | |
|---|---|---|---|
| LXVALUE | -0.075411 | -0.31198 | 0.044982 |
| LTOT | 0.14629 | -0.095339 | 0.046564 |
| LREER | 0.028043 | -0.026246 | -0.043885 |

long-run matrix, rank 3

| | LXVALUE | LTOT | LREER |
|---|---|---|---|
| LXVALUE | -0.15566 | -0.16890 | 0.41342 |
| LTOT | 0.13752 | -0.34895 | -0.55809 |
| LREER | -0.0015876 | -0.084315 | -0.15854 |

**Table A3: COFFEE (log Coffee)**

I(1) cointegration analysis, 1994 (3) to 2006 (4)

| eigenvalue | loglik for rank | |
|---|---|---|
| | 40.32116 | 0 |
| 0.22221 | 46.60366 | 1 |
| 0.11310 | 49.60424 | 2 |
| 0.015689 | 49.99957 | 3 |

| H0:rank<= | Trace test [ Prob] |
|---|---|
| 0 | 19.357 [0.478] |
| 1 | 6.7918 [0.608] |
| 2 | 0.79066 [0.374] |

Asymptotic p-values based on: Unrestricted constant

Unrestricted variables:
[0] = Constant
Number of lags used in the analysis: 4

beta (scaled on diagonal; cointegrating vectors in columns)

| | | | |
|---|---|---|---|
| Lcoffee | 1.0000 | -0.067539 | -0.17765 |
| UnitC | 4.6758 | 1.0000 | -0.81965 |
| LREER | 2.0317 | -1.1486 | 1.0000 |

alpha

| | | | |
|---|---|---|---|
| Lcoffee | -0.16141 | 0.80879 | 0.24018 |
| UnitC | 0.069142 | 2.3636 | -0.34950 |
| LREER | -0.044999 | -0.07305 | -0.022161 |

long-run matrix, rank 3

| | Lcoffee | UnitC | LREER |
|---|---|---|---|
| Lcoffee | -0.25870 | -0.14277 | -1.0167 |
| UnitC | -0.028406 | 2.9734 | -2.9239 |
| LREER | -0.036129 | -0.26529 | -0.029681 |

**Table A4. Cotton (LCOT)**
I(1) cointegration analysis, 1994 (3) to 2006 (4)

| eigenvalue | loglik for rank | |
|---|---|---|
| 1.409659 | 0 | |
| 0.11347 | 4.420654 | 1 |
| 0.010282 | 4.679026 | 2 |

| H0:rank<= | Trace test [ Prob] |
|---|---|
| 0 | 6.5387 [0.637] |
| 1 | 0.51674 [0.472] |

Asymptotic p-values based on: Unrestricted constant
Unrestricted variables:
[0] = Constant
Number of lags used in the analysis: 4

beta (scaled on diagonal; cointegrating vectors in columns)

| | | |
|---|---|---|
| LCott | 1.0000 | 0.09795 |
| LREER | -7.8330 | 1.0000 |

alpha

| | | |
|---|---|---|
| LCott | -0.37746 | -0.50147 |
| LREER | 0.016771 | -0.013756 |

long-run matrix, rank 2

| | LCott | LREER |
|---|---|---|
| LCott | -0.42658 | 2.4551 |
| LREER | 0.015424 | -0.14513 |

**Table A5. Tea (Ltea)**

I(1) cointegration analysis, 1994 (3) to 2006 (4)

| eigenvalue | loglik for rank | |
|---|---|---|
| | 115.9220 | 0 |
| 0.16420 | 120.4062 | 1 |
| 0.14668 | 124.3717 | 2 |
| 0.11634 | 127.4639 | 3 |

| H0:rank<= | Trace test [ Prob] |
|---|---|
| 0 | 23.084 [0.250] |
| 1 | 14.115 [0.079] |
| 2 | 6.1844 [0.013] * |

Asymptotic p-values based on: Unrestricted constant

Unrestricted variables:

[0] = Constant

Number of lags used in the analysis: 3

beta (scaled on diagonal; cointegrating vectors in columns)

| | | | |
|---|---|---|---|
| LTea | 1.0000 | -0.37115 | -1.1608 |
| UnitT | -1.0483 | 1.0000 | -1.1744 |
| LREER | -4.7972 | -0.73353 | 1.0000 |

alpha

| | | | |
|---|---|---|---|
| LTea | 0.14573 | 0.23198 | 0.035442 |
| UnitT | 0.074006 | -0.14397 | 0.079700 |
| LREER | 0.028021 | -0.032033 | -0.015214 |

long-run matrix, rank 3

| | LTea | UnitT | LREER |
|---|---|---|---|
| LTea | 0.018491 | 0.037581 | -0.83381 |
| UnitT | 0.034927 | -0.31516 | -0.16971 |
| LREER | 0.057570 | -0.043539 | -0.12614 |

**Table A6: Fish (Lfish)**

I(1) cointegration analysis, 1994 (3) to 2006 (4)

| eigenvalue | loglik for rank | |
|---|---|---|
| | 20.64721 | 0 |
| 0.15269 | 24.78955 | 1 |
| 0.14201 | 28.61851 | 2 |
| 0.010179 | 28.87429 | 3 |

| H0:rank<= | Trace test [ Prob] |
|---|---|
| 0 | 16.454 [0.353] |
| 1 | 8.1695 [0.225] |
| 2 | 0.51156 [0.542] |

Asymptotic p-values based on: No constant
Number of lags used in the analysis: 1

beta (scaled on diagonal; cointegrating vectors in columns)

| | | | |
|---|---|---|---|
| LFish | 1.0000 | -0.62673 | 0.56788 |
| LREER | -3.6734 | 1.0000 | -0.76285 |
| UnitF | 2.8315 | 0.30042 | 1.0000 |

alpha

| | | | |
|---|---|---|---|
| LFish | -0.045982 | 0.27897 | 0.00088841 |
| LREER | 0.0012243 | 0.011249 | 0.0010753 |
| UnitF | -0.061682 | -0.29033 | 0.0036741 |

long-run matrix, rank 3

| | LFish | LREER | UnitF |
|---|---|---|---|
| LFish | -0.22032 | 0.44720 | -0.045502 |
| LREER | -0.0052154 | 0.0059318 | 0.0079214 |
| UnitF | 0.12236 | -0.066555 | -0.25820 |

## Error Correction Model

An error correction export determination model is estimated using the saved residuals from the equilibrium relationships in period (t-1), as the error correction term, and using Ordinary Least Squares (OLS), focusing on only the equations where the exports of interest are the endogenous variables. The REER, unit prices/TOT, Rainfall (Rain), credit and/or lending rate and VAVB and relevant error correction terms are the explanatory terms. All variables except for error correction terms include four or three lags in the general equation. Following the general to specific modelling, the results of the reduced estimation results are indicated in Tables A7-A13.

### *Total Exports*

**Error! Reference source not found.** indicates that the main factors affecting total exports in Uganda are TOT and volatility of the VAVB. The coefficient on the TOT variable is positive and significant, indicating that an improvement in TOT would encourage exports. Specifically a 1% improvement in TOT would lead to an increase in exports receipts of 0.6%. Though the coefficient on VAVB is significant, it is positive which is not consistent with the fact that exchange volatility would create a risky business environment that would discourage exports. We do not establish a significant relationship between the REER and total exports. However, this was not the case for all the individual export commodities:

**Table A7: Total Exports (LXVALUE)**

Modelling DLXVALUE by OLS
The estimation sample is: 1994 (3) to 2006 (4)

| | Coefficient | Std.Error | t-value | t-prob | Part.R^2 |
|---|---|---|---|---|---|
| DLTOT | 0.559823 | 0.2139 | 2.62 | 0.012 | 0.1296 |
| LRain | -0.215072 | 0.04559 | -4.72 | 0.000 | 0.3261 |
| LRain_1 | 0.208712 | 0.04559 | 4.58 | 0.000 | 0.3130 |
| VAVB_1 | 194.420 | 81.33 | 2.39 | 0.021 | 0.1105 |

| | | | |
|---|---|---|---|
| sigma | 0.161524 | RSS | 1.20014132 |

| | | | |
|---|---|---|---|
| log-likelihood | 22.2927 | DW | 2.28 |
| no. of observations | 50 | no. of parameters | 4 |
| mean (DLXVALUE) | 0.027015 | var (DLXVALUE) | 0.0420771 |

| | | |
|---|---|---|
| AR 1-4 test: F (4,42) | = | 1.1590 [0.3425] |
| ARCH 1-4 test: F (4,38) | = | 0.52995 [0.7144] |
| Normality test: Chi^2(2) | = | 1.5303 [0.4653] |
| hetero test: F(8,37) | = | 0.65075 [0.7302] |
| hetero-X test: F(14,31) | = | 0.87453 [0.5912] |
| RESET test: F(1,45) | = | 0.11007 [0.7416] |

### *Coffee Exports*

Table A8 indicates that exports of coffee are mainly affected by rainfall and the cost of capital. In particular, a 1% increase in rainfall leads to a 0.8% increase in coffee exports. An increase in the lending rate of 1% reduces coffee exports by 0.6%.

**Table A8: Coffee**

Modelling **DLcoffee** by OLS
The estimation sample is: 1994 (3) to 2006 (4)

| | Coefficient | Std.Error | t-value | t-prob | Part.R^2 |
|---|---|---|---|---|---|
| Constant | -6.93144 | 1.609 | -4.31 | 0.000 | 0.2876 |
| LRain_1 | 0.417726 | 0.1407 | 2.97 | 0.005 | 0.1608 |
| LRain_3 | 0.418414 | 0.1430 | 2.93 | 0.005 | 0.1568 |
| DLRB_3 | -0.595015 | 0.2814 | -2.11 | 0.040 | 0.0886 |

| | | | |
|---|---|---|---|
| sigma | 0.296556 | RSS | 4.04548817 |
| R^2 | 0.424851 | F(3,46) = | 11.33 [0.000]** |
| log-likelihood | -8.08641 | DW | 2.2 |
| no. of observations | 50 | no. of parameters | 4 |
| mean (DLcoffee) | -0.0281997 | var (DLcoffee) | 0.140676 |

| | | |
|---|---|---|
| AR 1-4 test: F (4,42) | = | 0.77612 [0.5470] |
| ARCH 1-4 test: F (4,38) | = | 0.16267 [0.9559] |
| Normality test: Chi^2(2) | = | 15.880 [0.0004]** |
| hetero test: F(6,39) | = | 1.8019 [0.1241] |
| hetero-X test: F (9,36) | = | 1.1798 [0.3370] |
| RESET test: F (1,45) | = | 0.64517 [0.4261] |

### *Tea Exports*

Table A9 indicates that tea exports mainly adjust to deviations from long run equilibrium (VLTea_1). This implies that any shock to tea export production that drifts it away from its long run path would not last for a long period of time.

**Table A9: Tea**

Modelling **DLTea** by OLS
The estimation sample is: 1994 (4) to 2006 (4)

| | Coefficient | Std.Error | t-value | t-prob | Part.R^2 |
|---|---|---|---|---|---|
| VLTea_1 | -0.760893 | 0.1952 | -3.90 | 0.000 | 0.2405 |

| | | | |
|---|---|---|---|
| sigma | 0.217802 | RSS | 2.2770107 |
| log-likelihood | 5.66145 | DW | 1.7 |
| no. of observations | 49 | no. of parameters | 1 |
| mean (DLTea) | -0.00923472 | var (DLTea) | 0.0610996 |

| | | | |
|---|---|---|---|
| AR 1-4 test: | F (4,44) | = | 0.25156 [0.9072] |
| ARCH 1-4 test: | F(4,40) | = | 0.18587 [0.9444] |
| Normality test: | Chi^2(2) | = | 14.515 [0.0007]** |
| hetero test: | F(2,45) | = | 0.14963 [0.8615] |
| hetero-X test: | F(2,45) | = | 0.14963 [0.8615] |
| RESET test: | F(1,47) | = | 0.81867 [0.3702] |

### *Cotton*

Table A10 indicates that cotton exports are affected by the REER, though the effect is very small. In particular, a 1% increase in the REER (depreciation) is associated with an increase of 0.04% in exports. The exports of cotton are also negatively affected by their past values.

**Table A10: Cotton**

Modelling **DLCott** by OLS
The estimation sample is: 1994 (4) to 2006 (4)

| | Coefficient | Std.Error | t-value | t-prob | Part.R^2 |
|---|---|---|---|---|---|
| DLCott_1 | -0.868083 | 0.1040 | -8.35 | 0.000 | 0.6077 |
| DLCott_2 | -0.898980 | 0.1003 | -8.96 | 0.000 | 0.6409 |
| DLCott_3 | -0.696220 | 0.1039 | -6.70 | 0.000 | 0.4994 |
| LREER_2 | 0.0407374 | 0.0418 | 0.975 | 0.335 | 0.0207 |

| | | | |
|---|---|---|---|
| sigma | 1.34115 | RSS | 80.9407045 |
| log-likelihood | -81.8245 | DW | 2.38 |
| no. of observations | 49 | no. of parameters | 4 |
| mean(DLCott) | 0.0909413 | var(DLCott) | 5.34064 |

| | | | |
|---|---|---|---|
| AR 1-4 test: | F(4,41) | = | 2.2239 [0.0831] |
| ARCH 1-4 test: | F(4,37) | = | 1.2305 [0.3147] |
| Normality test: | Chi^2(2) | = | 5.5148 [0.0635] |
| hetero test: | F(8,36) | = | 2.2513 [0.0460]* |
| hetero-X test: | F(14,30) | = | 1.2923 [0.2685] |
| RESET test: | F(1,44) | = | 7.1652 [0.0104]* |

### *Fish Exports*

Table A11 indicates that a depreciation of the exchange rate *DL*(*REER*) leads to a 2.7% increase in fish exports (*DLFish).* This finding would support the view that an appreciation of the REER would hurt export competitiveness. It would also have negative implications for poverty reduction, given that fish is a rapidly growing export (constituting one of the largest merchandise export item) and being the main source of income for some 266,000 households, equivalent to around 1.2 million people or 4% of the population. This finding supports the earlier findings by Atingi-Ego and Ssebudde (2000). Finally, fish export is negatively related to its past values.

**Table A11: Fish**

Modelling *DLFish* by OLS

The estimation sample is: 1994 (3) to 2006 (4)

| | Coefficient | Std.Error | t-value | t-prob | Part.R^2 |
|---|---|---|---|---|---|
| DLFish_1 | -0.246832 | 0.1297 | -1.90 | 0.063 | 0.0715 |
| DLFish_2 | -0.313168 | 0.1291 | -2.43 | 0.019 | 0.1112 |
| DLREER_1 | 2.69754 | 1.115 | 2.42 | 0.019 | 0.1107 |

| | | | |
|---|---|---|---|
| sigma | 0.362687 | RSS | 6.18247887 |
| log-likelihood | -18.6893 | DW | 2.16 |
| no. of observations | 50 | no. of parameters | 3 |
| mean(DLFish) | 0.0271058 | var(DLFish) | 0.163697 |

| | | |
|---|---|---|
| AR 1-4 test: F (4, 43) | = | 1.3705 [0.2600] |
| ARCH 1-4 test: F (4, 39) | = | 0.18360 [0.9455] |
| Normality test: Chi^2(2) | = | 11.949 [0.0025]** |
| hetero test: F (6, 40) | = | 1.3145 [0.2732] |
| hetero-X test: F (9, 37) | = | 1.0233 [0.4401] |
| RESET test: F (1, 46) | = | 0.22424 [0.6381] |

### *Maize Exports*

Table A12 indicates that the main factors affecting maize export are rainfall and its past values. The coefficients on rainfall and maize past values are positive and statistically significant. Specifically, a 1% increase in rainfall would help increase maize export supply by 0.5%.

**Table A12: Maize**

Modelling **LMaize** by OLS

The estimation sample is: 1994 (3) to 2006 (4)

| | Coefficient | Std.Error | t-value | t-prob | Part.R^2 |
|---|---|---|---|---|---|
| LMaize_1 | 0.519855 | 0.1147 | 4.53 | 0.000 | 0.2997 |
| LRain_3 | 0.527776 | 0.1270 | 4.15 | 0.000 | 0.2645 |

| | | | |
|---|---|---|---|
| sigma | 0.775469 | RSS | 28.8648974 |
| log-likelihood | -57.212 | DW | 1.71 |
| no. of observations | 50 | no. of parameters | 2 |
| mean(LMaize) | 9.06644 | var(LMaize) | 0.897302 |

| | | |
|---|---|---|
| AR 1-4 test: F (4, 44) | = | 1.7419 [0.1579] |
| ARCH 1-4 test: F (4, 40) | = | 0.81784 [0.5214] |
| Normality test: Chi^2(2) | = | 2.8322 [0.2427] |
| hetero test: F (4, 43) | = | 0.34030 [0.8492] |
| hetero-X test: F (5, 42) | = | 1.133 [0.3554] |
| RESET test: F (1, 47) | = | 0.12753 [0.7226] |

### *Flower Exports*[37]

Table A13 indicates that the main factors affecting flower exports are the real effective exchange rate (*DLREER)* and cost of capital. Specifically, a 1% increase in the REER would help increase supply of flower export by 3%. An increase in the cost of capital by 1% would lead to a fall in flower exports by 1.5%. Rainfall and time (technological change) also affected the export of flowers. More rainfall discouraged the supply of flowers. In particular, a 1% increase in rainfall reduced supply of flower exports by 0.3%. Flower exports were also positively affected by developments that occurred over the review period as reflected by a positive and statistically significant coefficient on the time trend variable.

**Table A13: Flowers**

Modelling **LFLOWT** by OLS
The estimation sample is: 1996 (3) to 2006 (4)

| | Coefficient | Std.Error | t-value | t-prob | Part.R^2 |
|---|---|---|---|---|---|
| Constant | 8.87539 | 1.202 | 7.38 | 0.000 | 0.6021 |
| DLREER | 2.89405 | 0.8196 | 3.53 | 0.001 | 0.2572 |
| DLRB_1 | -0.880685 | 0.3507 | -2.51 | 0.017 | 0.1491 |
| DLRB_3 | -0.664239 | 0.3687 | -1.80 | 0.080 | 0.0827 |
| LRain_3 | -0.336656 | 0.1425 | -2.36 | 0.024 | 0.1343 |
| Trend | 0.0525796 | 0.0034 | 15.6 | 0.000 | 0.8715 |

| | | | |
|---|---|---|---|
| sigma | 0.253952 | RSS | 2.32170273 |
| R^2 | 0.895761 | F(5,36) = | 61.87 [0.000]** |
| log-likelihood | 1.20733 | DW | 1.84 |
| no. of observations | 42 | no. of parameters | 6 |
| mean(LFLOWT) | 7.8897 | var(LFLOWT) | 0.530309 |

| | | |
|---|---|---|
| AR 1-3 test: F(3,33) | = | 0.87931 [0.4618] |
| ARCH 1-3 test: F(3,30) | = | 0.90780 [0.4489] |
| Normality test: Chi^2(2) | = | 2.5220 [0.2834] |
| hetero test: F(10,25) | = | 0.97479 [0.4885] |
| hetero-X test: F(20,15) | = | 0.72240 [0.7550] |
| RESET test: F(1,35) | = | 3.9411 [0.0550] |

## Identifying the Effects of Aid

First, we carry out causality tests between the aid (LTFA) and the macroeconomic variables: money supply, CPI and REER. We estimate two sets of VAR models using equation 2. The first model includes four variables: aid (LTFA), broad money (BM3), headline CPI, and REER. The second model includes: aid (LTFA), broad money (BM3), underlying CPI, and REER. Both models include a constant and seasonal dummy. Our objective is to identify the effects of aid on prices and REER. The aid variable is placed first in the ordering based on the idea that it would not respond instantly to contemporaneous movements in other variables. All variables are included in the VAR in log form. Money supply is included in the system of equations because aid presumably affects prices and hence REER via changes in money. All variables in the VAR are included in levels, for the reason that

[37] The general equation Included the DLREER, Lrain, VAVB, Trend, and LRB.

even if differencing would be appropriate, it would yield no asymptotic efficiency gain in an autoregression. In addition, information would be lost by differencing data since, for instance, co-integrating relationships among variables would not be captured in the VAR (see for instance Sims, 1980 and Doan, 2000).

Each entry in Table A15 represents a joint significance tests in a VAR, including the aid variable LTFA, broad money, (LBM3) headline CPI (LCPIH), and REER (LREER). The entries in the first column of Table A15 suggest an orderly pattern in which aid (LTFA) helps predict (or granger causes) money supply (Row 3, Col. 3) at a 1% level of significance and helps predict the REER at 10% level. It does not help to predict itself and CPI. The entries in row 4 suggest that money helps predict (or granger causes) itself at a 1% level of significance (Row 4, Col. 3) and helps predict the REER at 5% level of significance (Row 4, Col. 5). It does not help predict aid and prices. The entries in row 5 suggest that prices help predict the REER but at only 10% level of significance. They do not help to predict the other two variables (aid and money) in the model. That aid granger causes money but does not granger cause inflation could be due to fact that due to sterilisation measures of liquidity by the monetary authorities, injections of liquidity into the economy following government expenditure would not be inflationary, though they would lead to short run increases in money supply. This is further reflected by the fact that money supply does not granger cause prices. However, both aid and money are associated with changes in the REER implying a possible aid induced effect on the REER, although conclusions cannot be established at this level until we examine the impulse response functions.

The last row of **Error! Reference source not found.** indicates marginal significance levels for the hypothesis that all lags of each of the variables can be excluded from the model. It is shown that all variables are important in predicting at least one of the other variables in the system. Finally, the first block of the statistics below **Error! Reference source not found.** shows single equation statistics and the second the system tests. None of the tests is significant at the 1% level, except the normality statistic for DLBM3, which may need reconsideration when a model of the system has been constructed and evaluated.

**Table A15: Identifying the Effects of Aid on REER and Headline Inflation**

**A.** Joint significance tests in VAR including Aid, Broad money 3, CPI-headline, and REER

| | Dependent Variable | | | |
|---|---|---|---|---|
| *p*-values for | LTFA | LBM3 | LCPIH | LREER |
| LTFA | 0.282 | 0.001 | 0.912 | 0.098 |
| LBM3 | 0.603 | 0.000 | 0.781 | 0.015 |
| LCPIH | 0.079 | 0.285 | 0.000 | 0.075 |
| LREER | 0.336 | 0.143 | 0.091 | 0.000 |
| Marginal significance levels for the hypothesis that all lags of a variable can be excluded from the model. | 0.000 | 0.000 | 0.000 | 0.000 |

1. Low probability values in A indicate that at conventional significance levels, the row variable Granger causes the column variable.
2. Estimates are based on vector autoregressions with 15 monthly lags of each variable.

LTFA : Portmanteau(12): 2.74021
LBM3 : Portmanteau(12): 4.52335
LCPIH : Portmanteau(12): 5.88843

LREER : Portmanteau(12): 8.62995
LTFA : AR 1-7 test: F(7,74) = 0.56950 [0.7784]
LBM3 : AR 1-7 test: F(7,74) = 0.49629 [0.8344]
LCPIH : AR 1-7 test: F(7,74) = 1.4099 [0.2142]
LREER : AR 1-7 test: F(7,74) = 0.98327 [0.4500]
LTFA : Normality test: Chi^2(2) = 3.0551 [0.2171]
LBM3 : Normality test: Chi^2(2) = 48.892 [0.0000]**
LCPIH : Normality test: Chi^2(2 = 1.8351 [0.3995]
LREER : Normality test: Chi^2(2) = 1.1715 [0.5567]
LTFA : ARCH 1-7 test: F(7,67) = 0.39424 [0.9025]
LBM3 : ARCH 1-7 test: F(7,67) = 0.46060 [0.8595]
LCPIH : ARCH 1-7 test: F(7,67) = 0.38242 [0.9095]
LREER : ARCH 1-7 test: F(7,67) = 2.2541 [0.0403]*
LTFA : hetero test: Chi^2(120) = 130.29 [0.2454]
LBM3 : hetero test: Chi^2(120) = 138.13 [0.1233]
LCPIH : hetero test: Chi^2(120) = 115.18 [0.6072]
LREER : hetero test: Chi^2(120) = 100.32 [0.9038]
Vector Portmanteau(12): 112.867
Vector AR 1-7 test: F(112,201) = 1.3233 [0.0434]*
Vector Normality test: Chi^2(8) = 55.375 [0.0000]**
Vector hetero test: Chi^2(1200) = 1231.4 [0.2579]

The results obtained are weaker when the underlying CPI is used in the VAR estimation. As Table A16 indicates, aid (LTFA) helps predict (or granger causes) money supply (Row 3, Col. 3) at a 1% level of significance, but does not help predict the REER, itself and underlying CPI. Money helps predict (or granger causes) itself (Row 4, Col. 3) and helps predict the REER (Row 4, Col. 5). It does not help predict aid and prices. Prices do not help predict the REER. They help predict money supply at 5% level in addition to predicting prices.

**Table A16: Identifying the Effects of Aid on REER and Underlying Inflation**

**A.** Joint significance tests in VAR including Aid, Broad money 3, CPI-underlying, and REER

| | Dependent Variable | | | |
|---|---|---|---|---|
| *p*-values for | LTFA | LBM3 | LCPIU | LREER |
| LTFA | 0.544 | 0.000 | 0.924 | 0.107 |
| LBM3 | 0.074 | 0.000 | 0.569 | 0.017 |
| LCPIU | 0.049 | 0.004 | 0.000 | 0.147 |
| LREER | 0.528 | 0.241 | 0.337 | 0.000 |
| Marginal significance levels for the hypothesis that all lags of a variable can be excluded from the model. | 0.000 | 0.000 | 0.000 | 0.000 |

1. Low probability values in A indicate that at conventional significance levels, the row variable Granger causes the column variable.
2. Estimates are based on vector autoregressions with 15 monthly lags of each variable.

LTFA : Portmanteau(12): 3.28894
LCPIU : Portmanteau(12): 3.28314
LBM3 : Portmanteau(12): 5.87938
LREER : Portmanteau(12): 4.95308
LTFA : AR 1-7 test: F(7,74) = 1.0020 [0.4369]
LCPIU : AR 1-7 test: F(7,74) = 0.54170 [0.8001]
LBM3 : AR 1-7 test: F(7,74) = 0.99715 [0.4403]
LREER : AR 1-7 test: F(7,74) = 0.91015 [0.5035]

```
LTFA        : Normality test:   Chi^2(2)    =  3.6327  [0.1626]
LCPIU       : Normality test:   Chi^2(2)    =  3.6782  [0.1590]
LBM3        : Normality test:   Chi^2(2)    =  22.376  [0.0000]**
LREER       : Normality test:   Chi^2(2)    =  3.5875  [0.1663]
LTFA        : ARCH 1-7 test:  F(7,67)      =  0.30667 [0.9485]
LCPIU       : ARCH 1-7 test:  F(7,67)      =  0.30782 [0.9480]
LBM3        : ARCH 1-7 test:  F(7,67)      =  0.57774 [0.7716]
LREER       : ARCH 1-7 test:  F(7,67)      =  0.81315 [0.5796]
LTFA        : hetero test:        Chi^2(120) = 132.90   [0.1985]
LCPIU       : hetero test:        Chi^2(120)  = 112.24  [0.6805]
LBM3        : hetero test:        Chi^2(120)  = 135.17  [0.1628]
LREER       : hetero test:        Chi^2(120)  = 105.73  [0.8204]
Vector Portmanteau(12):                        100.852
Vector AR 1-7 test:               F(112,201)  =  0.98182 [0.5374]
Vector Normality test:            Chi^2(8)    =  35.476  [0.0000]**
Vector hetero test:               Chi^2(1200)=  1218.7   [0.3473]
```

## Appendix 3: Computation of the REER

***Nominal Exchange Rate***

This is the nominal exchange rate of the Uganda shilling against the currency of the trading partner (e.g. US$/Uganda Shilling would for example mean that *1US$ = 1,500 Uganda Shilling, but not the reverse which is 1 Uganda Shilling = 0.0006.7US$*)[38]. It is obtained from the International Financial Statistics (IFS) with the exception of the Uganda Shilling to the USA Dollar, which is the monthly average of the mid-rate. The official mid-rate is the average of the weighted bid and ask rates in the inter-bank foreign exchange market. Commercial banks' transaction rates are assigned weights according to the size of the bank. The weighted averages for all the banks are thereafter summed up to get a single value, for the weighted buying or selling rates.

***The Nominal Effective Exchange Rate***

The NEER is an index measure of the local currency against the currencies of Uganda's trading partners. It is an index of weighted averages of bilateral exchange rates of the Ugandan shilling in terms of foreign currencies. The weights are based on trade shares reflecting the relative importance of each currency in the effective exchange rate basket.

***Methodology***

$$NEER = \prod_{i=1}^{k} e_i^{\alpha_i} \equiv e_1^{\alpha_1} \text{ x } e_2^{\alpha_2} \text{ x} \ldots\ldots \text{ x } e_k^{\alpha_k}$$

Where;

k = number of major trading partners;

e = the exchange rate of the Uganda Shilling against the trading partner i currency;

$\alpha_i$ = The total trade (imports plus exports) weight of country i with Uganda.

and $\sum_{i=1}^{k} \alpha_i = 1$

***Trade Weights***

The weights are derived from direction of trade statistics based on the value of bilateral trade (imports plus exports) with the trading partner.

Trade weight $\alpha_i = t_i/t$

Where;

$t_i$ = total volume of trade with country i.

t = total imports and exports of the economy.

[38] A decrease in the value of Uganda shillings used to purchase one (1) unit of US Dollar represents an appreciation of the Uganda shillings against the USA Dollar and vice versa. This therefore means that an increase in the REER represents a depreciation, while a decrease represents an appreciation.

***The Real Effective Exchange Rate***

The REER of a country is the nominal effective exchange rate adjusted for price differentials between the domestic and the foreign countries it trades with. Its importance stems from the fact that it can be used as an indicator of external competitiveness in the foreign trade of a country.

Using the Purchasing Power Parity definition, the REER is defined in the long run as the nominal effective exchange rate (e) that is adjusted by the ratio of the foreign price level ($P_f$) to the domestic price level (P); In Uganda's case, the core CPI is used to proxy for domestic prices. Mathematically, it can be shown as

$$REER = e \frac{p_f}{p}$$

From this definition, the decline in the REER can be interpreted as the real appreciation of the exchange rate; the reverse is true in the case of an increase.

***Foreign Prices***

The foreign prices as used in the REER computation are indices of CPI, or wholesale price indices (where available) of Uganda's trading partners, weighted by the trade shares

$$P_f = \prod_{i=1}^{k} \rho_i^{\alpha_i} \equiv \rho_1^{\alpha_1} X \rho_2^{\alpha_2} X \ ..... \ X \rho_k^{\alpha_k}$$

Where

k = number of trading partners;

$\rho$ = the Price index (Wholesale or Consumer) of the Country i; and

$\alpha_i$ = the export trade weight of country i and $\sum_{i=1}^{k} \alpha_i = 1$

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