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Impacts of Community-Based HIV/AIDS Treatment on Household Livelihoods in Uganda

by

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Dedication

To Kelton, Luther, and Pierrette.

That you daily concede and share

Is purely divine

And my love for you restlessly flowers

Fed by berries of labourer's sweat...

Oh, it's time to take time!

To praise the pills of salvation

And to henceforth embrace

Millions of brothers and sisters

Who many times a day heartily recite

Lengthy prayers of adherence to pills

Time to embrace by heart and mind

And to tread like upward scale bars

The bars to the temple of hope

Wherein treatment then daily jokes with history.

Abstract

We examine the effects of antiretroviral (ARV) treatment on the livelihoods of HIV/AIDS patients' households in Uganda. Incomes of ARV households improve, on average, over the treatment period by 59.5 percent. However, for 53 percent of households incomes are increasing, while for 47 percent incomes are decreasing. The increasing households earn more income from business and from remittances & gifts, while the decreasing households draw their income from forest & wild activities. Children's time use improves income from livestock among increasing households and income from forest & wild activities among decreasing households.

The effects of ARV treatment on incomes across treatment periods are positive among increasing households and negative among decreasing households, after controlling for heterogeneity. Education significantly contributes to income of increasing households. Initial wealth increases income of ARV recipients' households regardless of whether they are increasing or decreasing. The study could add to justifications regarding HIV/AIDS relief programs.

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AIDS:	Acquired immune deficiency syndrome
ARVs:	Antiretroviral drugs
CD4:	Cluster of differentiation 4
DFID:	Department for International Development
GDP:	Gross domestic product
HIV:	Human immune deficiency virus
SIDA:	Swedish International Development Cooperation Agency
UBOS:	Uganda Bureau of Statistics
UNAIDS:	Joint United Nations Programme on HIV/AIDS
UNDP:	United Nations Development Programme
USh:	Ugandan Shilling
WHO:	World Health Organization

1 Chapter One: Introduction

1.1 Background

More than half of the people in the world who are infected with Human Immunodeficiency Virus/Acquired Immune Deficiency Syndrome (HIV/AIDS) live in sub-Saharan Africa. In this region, HIV/AIDS continues to be a major health threat, pushing communities, households and individuals over the brink of poverty and perpetuating poverty traps in unprecedented ways (Joint United Nations Joint Program on HIV/AIDS (UNAIDS), 2006; Barrett *et al*., 2006; Barrett and Swallow, 2006; Krishna *et al*., 2004). HIV/AIDS is first among the ten most common causes of death in Africa; in 2000, it accounted for 20.4% of the total deaths in the continent (World Bank, 2006; World Bank, 2007). At the beginning of the Millennium, Food and Agriculture Organization (2002) forecasted that sixteen million more people may die of the pandemic by 2020 in the most affected countries of Africa. The impact of the pandemic is particularly pronounced in rural communities, far from existing medical resources and support, and for those who are more vulnerable to a downward spiral of poverty (Parker *et al.*, 2009).

The HIV/AIDS epidemic is not exclusively a health issue; it is more appropriately conceptualized from a multi-sectoral perspective that includes long term economic developmental implications for individuals, households and economies (UNAIDS, 2004). A case of HIV/AIDS in the family can result in substantial expenditures of resources, time, and effort on the part of household members. The time for income-generating activities that is forgone hinders labour output of both the patient and family care givers, which slows

down growth in economic activities (Food and Agriculture Organization, 2002).Wealth and income also get diverted into caring for the sick, while at the same time, the household's investments and income generating capacity are diminished by debilitation of household members (Schultz and Tansel, 1997).

According to several scholars, most indicators of human development have decreased steadily in Africa due to HIV/AIDS (Boutayeb, 2009; United Nations Development Programme, 2007). HIV/AIDS has widespread ramifications for farm and nonfarm sources of income of the poor. In Sub-Saharan Africa, agriculture is often the biggest contributor to livelihoods. Farming and other primary occupations contribute more than 70 per cent to the income of the population in many sub-Saharan African countries (United Nations, 2004). The HIV/AIDS epidemic, by depleting labour resources, has particularly severe effects on farming in rural areas which rely "almost exclusively on family labour –the most important productive resource that poor people have" (IFAD, 2001, p.4).

However, agriculture is not necessarily as important as it used to be in rural Africa, because households have been diversifying into off-farm activities (Barrett et al., 2001; Reardon *et al.*, 2000; Bryceson, 2002). But off-farm income is also adversely affected by the outbreak of HIV/AIDS. Inadequate treatment worsens absenteeism at work with repercussions for wage income of affected households. Hence, households may be pushed below the subsistence level of income (Krishna et al., 2006), depending upon the time reallocation efforts of other household dwellers with regard to

productive and unproductive works (Thirumurty et al., 2008; d'Adda et al., 2009).

At the same time, the effects of HIV/AIDS may also magnify the effect of other adverse shocks such as death of household's key remittance provider, malnutrition, chronic diseases (e.g. diarrhoea, tuberculosis, malaria), and others. Afflicted households, in an attempt to cope with a shock may deplete their assets (Senefeld, 2005) to a point where they are pushed into poverty traps, perpetually losing the ability to overcome the constraints associated with entering more profitable activities (Barrett and Swallow, 2006). Illness can also cause an increase in consumption needs among poor individuals, thereby raising the demand for credit (Ray, 1998, p.531). Poor households may be forced to borrow more, or reduce their savings.

Highly Active Antiretroviral Therapy[1] was first introduced in 1996, but only 7 percent of those who needed treatment in developing countries were actually receiving it in 2004 (World Health Organization (WHO), 2004). According to the UNAIDS and WHO (2009), access to HIV/AIDS treatment using antiretroviral (ARV) therapy increased by nearly thirty times to reach 2.9 million patients in sub-Saharan Africa over the 2003-08 period. Despite this progress, only 44% of the 6.7 million HIV/AIDS patients in Africa have access to treatment (UNAIDS and WHO, 2009).[2] To fill the gaps in the availability of broad based treatment, several initiatives led by governments, NGOs and aid organizations have been launched in recent years (United

[1] Highly Active Antiretroviral Therapy refers to the approach whereby the HIV patient takes typically 3 to 4 antiretroviral drugs in combination (AIDS 2010, 2010).
[2] Coverage is low due to insufficient expansion and decentralization of treatment sites to remote populations, poor transport and communication infrastructures, stigma, among others.

Nations Development Programme (UNDP), 2007; UNAIDS, 2010). The increased availability of ARV drugs in rural areas is expected to increase equity in health care access and reverse some of the debilitating effects of the disease on rural incomes.

Despite programs and aid to respond to this pandemic, research on the economic impact of HIV/AIDS, and subsequent treatments, on household livelihoods is somewhat scarce. While a deterioration in household livelihood choices are the main mechanism through which the long term economic effects of HIV/AIDS appear, little economic research has been conducted on the impact of treatment such as ARV therapy at a household level. Consequently, links between treatment and livelihood choices are still poorly understood.

This research attempts to contribute to the literature by examining the effects of participation in a community based HIV/AIDS treatment program on household income and livelihood choices, using a set of panel data from rural Uganda. This research provides a rare opportunity to simultaneously investigate health and development issues with a survey that covers a broad range of economic and resource use activities.

Structural changes in household livelihood choices and the reallocation of resources, such as labour, are the main mechanism through which the long term economic effects of HIV/AIDS propagate. The coping mechanisms of distressed households inherently involve tradeoffs that can dampen household investment in productive assets such as education. These effects aggregated over many households and over time can set the overall economy on a low

growth or declining trajectory as productivity, savings and human capital start to dwindle. This project will shed light on these aggregate implications by empirically examining the impact of a community-based treatment program on household livelihoods, and draw implications for the overall economy. The project will contribute to the field of economic development by examining how micro-level health shocks constrain economic growth and by analyzing the efficacy of carefully devised interventions in removing those constraints. Establishing an effective measurement of progress already achieved through treatment can also directly contribute to making the case for HIV/AIDS relief programs for improving rural livelihoods.

1.2 Objectives

The main objective of this study is to investigate the effects of ARVs on the livelihoods of rural households in the district of Kabarole, Uganda. The specific objectives are as follows:

1) To characterize the livelihood portfolios of households in quantitative terms regarding income and time use; and
2) To examine the effects of treatment on livelihood outcomes across treatment program periods while controlling for other factors (e.g. socio-demographic and geographic characteristics).

1.3 Outline of the Thesis

The remaining part of this study comprises five chapters. In Chapter 2, we review studies on how HIV/AIDS treatment influences households' strategies to earn a living. In Chapter 3, we give background on the study site and then present the data collection process. In Chapter 4, we describe the empirical

methods involved in modeling the effects of HIV/AIDS treatment on livelihood outcomes. In Chapter 5, we present and discuss the main results of the study. In Chapter 6, we present a summary, policy implications and some limitations of the study.

2 Chapter Two: Literature Review

This chapter reviews studies on how HIV/AIDS treatment influences households' strategies to earn a living. It comprises four parts. First, we describe the two livelihood measures involved in this study, namely income and wealth. Second, we discuss the extent to which HIV/AIDS impedes households' livelihood pursuits. Third, we review literature on the effects of ARVs on income and activities contributing to income. Fourth, we draw from the more general household livelihood literature to present some non-ARV determinants of household income.

2.1 Household livelihoods: wealth and income

A commonly accepted measure of household[3] well-being and livelihood is household income (Ellis, 2000; Department for International Development (DFID), 1999; Scoones, 1998). Income is generated from livelihood strategies which include activities such as cropping, raising livestock, gathering woodland products, and earning wages. The potential of these activities to generate income depends upon various livelihood assets including natural, physical, financial, human, and social capital (DFID, 1999; Ellis, 1998; Ellis, 2000). Taken at a given point in time, the livelihood assets can be seen as household wealth used to generate income. Livelihood assets "offer a store of wealth and a source of income" (Barrett and Reardon, 2000, p.10). Aghion and Bolton (1997) emphasize that wealth is a driver of access to

[3] Ellis (1993) considers a 'household' to be a "social unit defined by the sharing of the same abode or hearth". Generally, the term refers to the group of people living together in the same home.

income-generating activities, without which the poor in Africa may not easily get capital to start a business and improve income growth.

A number of sources provide definitions of *income*. Barrett and Reardon (2000) consider income to be the result of the valuation at market prices of goods and services produced by the activities that arise from productive assets (Barrett and Reardon, 2000). Household income is referred to as "all current receipts, whether monetary or in kind, that are received by the household or by the individual members of the household, and which are available for, or intended to support, current consumption" (The Australian Bureau of Statistics, 2009, p.3). By putting emphasis on current cash and in-kind receipts, this definition agrees with the International Labour Office's (2003) definition of income. In conformity with the above definitions, this study considers the sum of periodical (e.g. quarterly, annual) proceeds earned from all activities undertaken as household income.

The notion of wealth depends upon the context and may vary across time, regions, and social classes. In general, *wealth* is "the value of assets minus debts" (Davies, 2008, p.2). Wealth in this study refers chiefly to livelihood assets comprising the five types of capitals earlier mentioned: natural (e.g. land, fish pond), physical (e.g. radio, cart), human (e.g. education, health, skill) social (e.g. membership in associations), and financial (e.g. credit worthiness) capitals. Access to wealth can be facilitated by the institutions (property rights), the social relations (ethnicity, gender), and the organizations in place (community associations, local government) (Ellis, 2000; DFID, 1999). Better access to more wealth can support the activities

households engage in, thereby strengthening their chances to earn higher income and secure livelihoods.

Wealth can be measured through techniques involving quantitative questionnaires or through techniques using Participatory Wealth Ranking[4] approaches. Regarding quantitative questionnaires, data on savings, housing quality, education, nutritional status, and other capitals, are collected and combined by means of statistical tools[5], by simple count of variables, or by weighting based on field information (Hargreaves et al., 2007; Henry et al., 2003). For instance, in Ghana, Burger et al. (2006) construct an index of accumulated wealth holdings using data on the ownership of non-financial assets such as land, livestock and housing. Regarding participatory methods, groups of community members independently rank households in their community according to their own perception of wealth (Gibbons and Simanowitz, 1999; Zeller et al., 2006; Feulefack et al., 2006).

2.2 The adverse effects of HIV/AIDS on livelihoods

A major impediment to the livelihood pursuits of households in sub-Saharan Africa is the HIV/AIDS pandemic. One impact of HIV/AIDS on households is that it increases costs, hence reducing disposable income (Barnett et al., 1995; Shackleton et al., 2006). Treatment for HIV/AIDS patients involves continually taking antiretroviral (ARV) drugs for the rest of their lifetimes. In sub-Saharan Africa, the cost of ARVs has been subsidized but often remains a significant proportion of income for low-income households (Onwujekwe et al., 2009; Tumushabe, 2006).

[4] See Gibbon and Simanowitz (1999) for the description of Participatory Wealth Ranking.
[5] One of such tools is Principal Component Analysis (PCA) discussed in Henry et al. (2003).

HIV/AIDS also has a number of other effects on household welfare. First, HIV/AIDS depletes human capital. Studies have shown that losses of labour, skill and experience are the highest in countries where HIV/AIDS prevalence rates are high (Cohen, 2002). As a result, there may be interruption of production, decline in the quality of manufactured goods, and thereby delays in economic and social progress (Cohen, 2002; Barnett et al., 1995). Moreover, HIV/AIDS often strikes the most productive age groups who are the household's key resource providers (UNAIDS and WHO, 2009).

The rising morbidity of HIV/AIDS patients causes productivity and engagement in income-generating activities to decline at the household, community, public, and private sector levels (Hankins, 2007). In Uganda, Barnett and Blaikie (1992) examine modifications of farming systems due to HIV/AIDS in the household and discover that HIV/AIDS constrains household dwellers to resort to adaptive strategies[6] that are most likely to decrease income and household's self-provisional ability. In Kenya, Yamano and Jayne (2002) found that HIV/AIDS can bring about a decline of 68 percent in net household production. In Zimbabwe, a decrease in the availability of labour could reduce production levels by 37 to 61 percent in a mix of crops (Kwaramba, 1997). The decline in agricultural production may be due to the affected household growing less labour-intensive crops and less crop varieties on a reduced portion of land (United Nations, 2004). However, not all studies find a significant reduction in agricultural production due to HIV/AIDS. This view is supported at the macro level in a study conducted in

[6] As examples of adaptive strategies, Barnett and Blaikie (1992) mention: intercropping, increment of the lengths of working days, switching to other activities (e.g. gathering and hunting), rural migration, staggering of agricultural activities (either in space or in time).

Africa by Dixon et al. (2001) who conclude that irrespective of the country, the macroeconomic impacts of the epidemic upon economic growth are not clear when the level of HIV/AIDS prevalence is relatively high.

A number of studies have shown that HIV/AIDS contributes to widen inequalities in the distribution of income within a society (Casale and Whiteside, 2006). Income of the poorest group of households is often the worst affected by the adverse effects of HIV/AIDS (Greener et al., 2000). Theodore (2001), in his study of Caribbean countries, points out that members of the upper income group, given their endowment in assets such as savings, land, and capital, do not just rely on labour like the members of the lowest income groups. Hence, the upper income group's member may be better placed to withstand an illness shock compared to the poor whose sole productive asset, labour, is deeply eroded by HIV/AIDS.

The onset of HIV/AIDS in the household also has negative consequences on the wealth of households. Lower wealth can translate into reduced income or slow income growth. The United Nations Development Programme (2007) emphasizes the impacts of HIV/AIDS on livelihood assets in terms of households liquidating physical assets to cover food and funeral expenses and gifts to caregivers. Senefeld (2005), in a study in Malawi, finds that 37.7 percent of HIV/AIDS infected households reported selling assets in order to cover household food needs, daily household expenses, and hospital and doctor bills.

2.3 The beneficial role of ARVS

ARVs can reverse some of the debilitating effects of the HIV/AIDS pandemic on the livelihoods of people. ARVs can suppress the virus and terminate its reproduction. In response to treatment, “people near death became healthy again” (UNAIDS, 2010, p.48). Treatment can bring about longer life expectancy and higher quality of life (Cleary et al., 2004). There have been a number of studies with respect to the beneficial effects of ARVs on (1) mortality, (2) labour, and (3) time reallocation.

2.3.1 Effects of ARVs on mortality

A number of studies, both from developed countries and developing countries, have established that ARVs reduce mortality. In developed countries, mortality rates after receiving ARVs can be as low as 2.4 percent after three and a half years, depending upon the initial characteristics of the patients (Egger et al., 2002).

In developing countries, ARVs allow patients to live up to an average of 8.33 years longer than without treatment (Cleary et al., 2004), while being professionally active. For example, in northern Malawi, Jahn et al. (2008) find a reduction in mortality of 35 percent among adults from 15 to 59 years due to ARV therapy in locations of highest disease prevalence. In Uganda Alibhai et al. (2010b) find that mortality in female patients receiving ARVs is lower than mortality in males by 4.5 percentage points.

2.3.2 Effects of ARVs on labour productivity of patients

Studies show that the initiation of ARVs boosts labour productivity through (1) improvement in labour workforce participation and (2) the drop in

absenteeism at work. For example, in Kenya, Thirumurthy et al. (2008) compare the labour outcomes of ARV recipients with respect to wage labour, farm labour and nonfarm business labour. They find that generally participation in the labour workforce and total hours worked by patients receiving ARVs increase, while absenteeism drops. Thirumurthy et al. (2008) also show that effects of ARV treatment on labour workforce participation and hours worked can vary according to the number of patients in the household, the age, and the gender of household dwellers. Double-patient households benefit more from ARVs with regard to labour workforce participation than single-patient households.

Muirhead et al. (2006) examine the impacts of ARVs on absenteeism of employees in South Africa. They find that the mean worker absence drops from 7.5 days/month to 2.9 days/month after 6 months of treatment. Larson et al. (2008) study a Kenyan tea plantation and find that differences in days worked between ARV patients and a control group disappear by the fourth month of treatment. A literature review conducted by Beard et al. (2009) points out that absenteeism in developing countries drops significantly during the first year of treatment.

2.3.3 Effects of ARVs on time reallocation patterns

ARV therapy boosts productive time use of recovering patients and their caregivers. In South Africa, Kakinami et al. (2010) find that urban and rural patients on ARVs are 17 and 41 percent, respectively, less likely to receive assistance with activities of daily living, such as cooking, cleaning, and washing (Kakinami et al., 2010). In Kenya, D'Adda et al. (2009) find that female patients on ARVs are able to increase the amount of time they spend

on water and firewood collection. Moreover, as patients get better, the burden of household tasks on other household dwellers, and children in particular, drops. Allocation of children time changes, as adult patients receive ARVs, in that they may spend more time at school (Thirumurthy et al., 2008). The change is higher in double-patient households on ARVs than single-patient households in that children in the former may go out to look for work more than children in the latter. Furthermore, d'Adda et al. (2009) show that women receiving ARVs are able to spend more time on labour-demanding non-market tasks (e.g. fetching water), while men recovering from HIV/AIDS are more likely to spend time on income-generating activities (cropping, own business).

2.3.4 Effects of ARVs on income

The positive effects of ARV therapy on mortality, labour productivity, and time reallocation end up boosting household income. The effects of ARV treatment on household income in sub-Saharan Africa have been examined in South Africa where Chhagan et al. (2008) conduct an 18-month economic evaluation of ARVs on 249 patients and their households. Income of ARV patients' households increases by 10 percent. Income improves due to changes in employment status, as patients are able to work extra hours, or secure new employment, and due to the amounts of social grants (i.e. disability grants, and child support grants).

However, the impact of ARVs on income may be moderated by reallocation of time within the household. As the recovering patient works to increase household income, other dwellers may take advantage of the reduced care-giving time not for paying off jobs, but for more non-remunerating

activities such as leisure (Thirumurthy et al, 2008; d'Adda et al., 2009). As a result, the cross-income effects for the household under ARVs remain unclear.

2.3.5 Effects of income on the effectiveness of ARVs

A number of studies show that income may influence how well patients adhere to ARV treatment.[7] Income influences adherence through (1) access to transportation, (2) access to food and (3) the patient's knowledge of the disease.

Regarding access to transportation, in south-western Uganda, a study by Tuller et al. (2009) points to transportation costs that compromise adherence to treatment: by increasing the frequency of missed doses and medical appointments. Duff et al. (2010) point out that transport cost from dwelling to the health facility is a big barrier to accessing ARVs (along with other significant barriers such as stigma, provider-patient interactions, and waiting time in a queue).

Reduced access to food affects adherence by worsening drugs side-effects (Byron et al., 2008; Gillespie, 2008). Stevens et al. (2004) point out that poor eating habit is one of several factors that can hinder the concentration of ARV drugs at their active location. In the Central province of Kenya, Wanjohi (2009) finds a positive and highly significant association between the lack of food and non-adherence. Moreover, adherence is often greater in treatment programs whereby macro-nutrient supplements

[7] In Uganda, Kiguba (2007) discusses cases of imperfect adherence of the patient to ARVs including: the simultaneous stopping of all pills for a month and the altering of one element in the initial combination of drugs.

(carbohydrates, fats, and proteins) are given to ARV recipients (Byron et al., 2008).

The limited level of awareness about HIV/AIDS issues can be correlated with low adherence outcomes among ARV recipients (Kalichman et al., 1999). Among low-income HIV-positive Spanish-speaking Latinos in the USA, poor "health literacy" is one of the factors found to be frequently correlated with non-adherence to treatment (Gwen van Servellen, 2005). Bloom et al. (2001) report findings from Cambodia, where women from the wealthiest quintiles are twice as likely as those from the poorest quintiles to know how to prevent HIV/AIDS transmission.

In contrast to those studies that claim important income effects on the efficacy of ARVs, a recent literature review suggests otherwise. Examining 27 studies from sub-Saharan African countries and 31 studies from North America, Mills et al. (2008) conclude that encouraging levels of adherence are being attained in Africa whereas the level of adherence in North America needs improvement. Hence, low socio-economic conditions may not always be of negative influence to adherence to ARVs.

2.4 Non-ARV determinants of income in developing countries

If we wish to assess the impacts of ARVs on income, there are other variables influencing income that we need to understand. In general, theoretical and empirical models point to seven broad categories of factors that influence household income: (1) endowments or wealth including access to credit and equity assets, (2) macroeconomic environment, (3) seasonality, (4)

socio-demographic characteristics of the household, (5) technology, (6) geographical attributes, and (7) characteristics of HIV/AIDS patients.

2.4.1 Wealth

Wealth plays a key role in the determination of household income. Jayne et al. (2005) indicate a positive relationship between farm income and access to land in a study covering five African countries. Nicholson et al. (2004) also find that the number of wheeled carts and of vehicles owned have a positive effect on income. In addition, business income can increase existing wealth, thereby increasing chances of a poor household to cross the poverty line (Burger et al., 2006; Aghion and Bolton, 1997).

2.4.2 Macro-economic environment

Changes in the macro-economic environment influence households by changing prices that must pay for inputs and end-products. Fluctuations in prices at the national or international level can be a source of adversity for poor people, especially in the rural areas of developing countries (Gillespie, 2008; DFID, 1999). Reforms, such as the devaluation of the exchange rate, often lead to changes in relative prices across economies. Households that are producing tradable crops (e.g. coffee, cocoa) can profit from the devaluated price to sell more of their produce and earn higher returns (Ellis, 2000). However, currency depreciation may hamper participation in production activities because of the surge in costs of imported inputs such as fertilizer; especially, when relevant accompanying policies to promote substitute products such as compost are not put in place (Jaza, 2009). A trend variable is often used in empirical studies to capture changes in macroeconomic condition over time (SHAZAM, 2008).

2.4.3 Seasonality

Seasonal effects are not often the same from one environment to the next and can be linked to factors including “local ecology, natural rhythm of plants and animal growth, local production, income-generating activities and cultural patterns” (Institute of Development Studies, 1986, p.1). For instance, Lipton (1986) remarks that in sub-Saharan Africa the effects of seasonality are extreme compared to other developing regions due to the limited practice of irrigation and the physical characteristics of soils which are often too porous.

In the context of developing countries, Teokul et al. (1986) conduct a literature review on seasonal variations and identify three factors with reference to seasonality: economic work activity, food intake, and body weight changes. Regarding seasonality in economic work activity, they find a constant pattern across existing sources, which supports that the level of economic activity varies throughout the year. For example, there are peak seasons and slack seasons in the labour market. Dorward and Mwale (2006) also account for periods in the seasonality of labour. Regarding seasonal variations in food intake, Teokul et al. (1986) find that such variations are high in areas of only one major crop a year, and are less where climatic conditions permit more than one crop a year. In addition to these fluctuations in food availability throughout the year, seasonal variations in food intake may also be due to the time available for carrying out different food-related activities (Wandel, 1992). Regarding seasonal variations in weight changes, Teokul et al. (1986) find that body mass index is seasonal, reaching a maximum at post-harvest and a minimum at pre-harvest among cropping households. Among pastoralist, Body weight rises during the rainy season due to high milk supply

and less activity to get fresh pasture as opposed to the dry season. All these findings indicate that the seasonal variations can bring about differences in productivity across periods of the year, which will negatively or positively influence income.

2.4.4 Socio-demographic characteristics

Socio-demographic characteristics can be important factors in influencing household income. We present a literature review on four socio-demographic categories: (1) education, (2) age, (3) household dependents, and (4) household adults.

Education: Low levels of education are often associated with low household incomes in most sub-Saharan African studies. Low levels of education can reduce the promptness of access to information, which negatively affects income (Pingali, 2005). Also, education is an important determinant of rural households' ability to enter into remunerative nonfarm employment in Africa (Barrett et al., 2001). Similarly, Dieden (2004) finds that in South Africa, both the share of adults with primary education and the share with secondary education positively influence the income of households. Enete and Achike (2008) in Nigeria find that the level of formal education of the household head positively influences the level of non-crop income earned by the household. In rural China, Wan and Zhou (2005) find also a positive influence of education on income.

Age: Studies suggest that age of household adults influences income, but the directional effects of age on income are inconclusive. Skirbekk (2003) finds that productivity increases with working age, up to nearly 50 years, after

which it reduces depending upon the nature of the work. While a few studies account for the non-linear effects of age on income, many do not. Some authors specify an income function including, among other variables, age squared which is expected to negatively influence income as opposed to age which has a positive effect (Wan and Zhou, 2005; Takasaki et al., 2010). In rural Kenya, Nicholson et al. (2004) find that the age of the household head has a negative association with gross cash income, which may be explained by a process whereby younger households like to focus more on higher-paying non-agricultural types of activities. In South Africa, Kingdon and Knight (2006) find that groups of adult household members aged 26 years and above have a positive impact on income, as opposed to those aged 16 to 25.

Household dependents: There are mixed results in the literature regarding whether household dependents influence income positively or negatively. In three districts of Mozambique, Tschirley and Weber (1994) investigate the impacts of dependents, i.e. children aged below 10 years and elderly adults aged above 65 years, and find mixed results. In Nigeria, Enete and Achike (2008) find that the proportion of household dwellers aged either less than or equal to 15 or greater than 65 positively influences the level of non-crop income earned. Conversely, Dieden (2004) finds that an increase in the number of children aged 0-7 years or youth aged 8-15 years negatively influences household income. A similar result is found by Kingdon and Knight (2006) in South Africa where the number of children in the household who are aged 0-15 negatively influence income.

Household adults: The influence of the number of household adults on income can also be either positive or negative. Nicholson et al. (2004) in

Kenya find that the number of adults (aged 14 years or older) in the household positively influences monthly gross cash income. Kingdon and Knight (2006) in South Africa find a similar result for age groups of household members above 25 years. In contrast to these findings, in the rural area of Mozambique, Tschirley and Weber (1994) find that the effect of the number of non-elderly adults on income from cash crop sales and on off-farm cash varies across districts.

2.4.5 Technology in use

The ability of farm households to choose and grow the right crop variety influences income because it will impact yields and production. In Nigeria, Mafimisebi (2008) finds that the variety of cassava cultivated positively influences farm income. Similarly, Wan and Zhou (2005) in China find the type of cropping patterns to be significant and positive in influencing income. These findings are in line with crop production theory with regard to the evidence that cropping techniques influence yields. Hence, better technological choices made during farming can have positive effects on income.

2.4.6 Geographical attributes

Geographic characteristics are important factors that either positively or negatively influence household income as underlined by many empirical studies. A village that is favourably located in terms of infrastructures of access (e.g. roads, proximity to major city) often has more opportunities to develop than the village that does not. Such development opportunities are supplementary assets for growth across sectors of activities (Hazell and Roell, 1983) and can also offer possibilities for diversification (e.g. across sectors,

across opportunities) to earn higher income (Reardon et al., 1992). Mohapatra et al. (2006) find that livelihood strategies of the most remote and lowest income regions are mainly subsistence agriculture. Proximity of regions to urban areas is synonymous with larger demand for goods and services, better access to information, market infrastructure, and lower transaction costs, among others (Mohapatra et al., 2006). Campbell et al. (2003) find remoteness to be one of the factors that make investment benefits in some places low relative to others. This conforms to Gallup et al.'s (1998) findings that location affects income by influencing transport costs, disease occurrences, and agricultural productivity.

2.4.7 Patient characteristics

Patients' knowledge about HIV/AIDS may be seen as human capital that positively affects productivity and increases income. The patient's level of awareness about the illness is more likely to lead to effective treatment via improvement in adherence. Kipp et al. (2009) find that ARVs knowledge among patients in the population of Kabarole, Uganda, is high, and suggest that the level of knowledge is important for achieving adherence to ARVs. Improvement in adherence facilitates prompt recovery and enjoyment of better health status, which improves the patient's productivity.

Whether the individual suffering from HIV/AIDS and receiving ARVs is male or female can also influence household income. In Kenya, Larson et al. (2009) find that HIV-infected female workers on ARVs are less productive than the general female workforce, while male workers on ARVs maintain a work pattern similar to the general male workforce except during the initial five months on ARVs. D'Adda et al. (2009) point out that the differences in

gender could mean differences in labour adaptation, thereby causing differences in income to be earned.

2.5 Conclusion

Numerous studies support the claim that HIV/AIDS is detrimental to household livelihoods, while ARV therapy has positive impacts on the household's economic activities. As treatment proceeds, household members can help rebuild assets, income, and secure household livelihoods. The literature establishes that the economic well-being of households improves due to the beneficial effects of ARVs on mortality, labour productivity, and intra-household time reallocation. In addition, improvements may vary across socio-economic strata.

Studies that focus on the non-clinical outcomes of ARV therapy in developing countries are recent and limited in number (Beard et al., 2009; d'Adda et al., 2009). The non-clinical outcomes most commonly found in the literature relate to the effects of ARVs on mental health, quality of life, labour productivity, and subjective well-being. It is hard to locate studies that focus on the effects of treatment on household income. Our contribution to the existing literature consists of characterizing the portfolio of ARV patients' households in terms of income and time use and of examining the impact of ARVs on household income over a year.

3 Chapter Three: The Study Site and Data Collection in Uganda

This chapter gives background on the study site and then presents the data collection process. The chapter consists of three parts. First, we present the country profile and relevant events about HIV/AIDS treatment, while paying special attention to Kabarole district where the study took place. Second, we describe the larger research project of which this study is a part. Third, we discuss the methods used to collect and prepare data, and to construct required variables.

3.1 Uganda and HIV/AIDS treatment

Uganda is an East African country with diverse characteristics (see Appendix A1 – map of Uganda). Ugandan people are engaged in the challenge to counter HIV/AIDS via prevention and treatment through the state, private sectors, and civil society organizations. In this section, we present the main features of Uganda, events related to prevention and treatment of HIV/AIDS, and describe the district where the data were collected.

3.1.1 Uganda

Uganda has an equatorial climate moderated by altitude. The temperatures vary across the regions of the country, with a minimum range of 8-23 to the maximum range of 18-35 degrees Celsius. The rainy seasons also vary, but are often from March to May and September to November, with the wettest month being April, while the driest seasons are often from December to February and from June to August. Uganda's population is growing fast, is diverse in peoples and cultures, and is subject to rising urbanization. The

average annual growth rate of Uganda population increased from 2.5 to 3.2 percent between 1991 and 2002 (Uganda Bureau of Statistics, 2002). The population of Uganda is approximately 31.7 million (World Bank, 2008). There are several tribes, the largest of which are the Baganda, Basaga, Bakiga, and the Banyankore. Approximately 88 percent of the people were living in rural areas in 2002, but urbanization has been increasing (Uganda Bureau of Statistics, 2002).

Uganda has achieved progress in economic and human development. The country's GDP increased between 4.7 percent and 6.6 percent per annum from 2001 through 2006 (Uganda Bureau of Statistics and Macro International Inc., 2007). In addition, according to the Uganda Human Development Report (2005), the country made improvements between 2000 and 2005.

3.1.2 HIV/AIDS in Uganda

Mobilization for HIV/AIDS prevention in Uganda has succeeded in attracting worldwide recognition. While the spread of HIV/AIDS was growing in the world at large, especially in Sub-Saharan Africa, prevalence rates were dropping in Uganda. This result has been referred to as the "Ugandan success story". Prevention success is attributed to the "zero grazing" campaign that promoted monogamy and that involved grassroots organizations from different social orientations (e.g. gender, religion, and tribe), including HIV-infected people. The campaign led to a 70-percent decline in HIV prevalence between the early 1990s to the mid-2000s (Stoneburner and Low-Beer, 2004). One

main reason for the decline was a communication network that led to changes in behaviour regarding casual multi-partner sex (Green et al., 2006).[8]

Given the progress achieved and a good relationship with the international community of donors, the state scaled up ARV treatment in 2004. The number of new ARVs service delivery points increased from 3 in 2001 to 53 in 2004 (Madraa, 2005). But the fight against HIV/AIDS in Uganda remains a challenge. In 2006, the average adult HIV prevalence was 6.4 percent for both males and females aged from 15 through 49 years (Uganda AIDS Commission, 2006). Sero-prevalence varies nation-wide: from 2.3 percent in the northwest to 8.5 percent in the central region (Uganda AIDS Commission, 2006).

Notwithstanding earlier gains, there seems to have been gradual resurgence of risky behaviour following adoption of the "zero-grazing" campaign (Tumushabe, 2006). The rate of adult HIV prevalence remains stagnant at 6.0-6.5 percent, prompting the Director General of the Uganda AIDS Commission to recognize that "despite all the effort and gains, HIV/AIDS still poses a real and big challenge to the nation" (Uganda AIDS Commission, 2006). Faced with an ongoing pandemic, the Ministry of Health developed training tools and trained health workers in districts on the basic home-based care (Tumushabe, 2006).[9]

[8] Morris (1997) found Ugandan men to have multiple partners.

[9] Non-state organizations also accompany the state in its initiative to offset the pandemic. Tumushabe (2001) reports over 2000 Non-Governmental Organisations and Community-Based Organisations working on HIV/AIDS, following a release from the Umbrella Uganda National AIDS Service Organizations.

Though HIV/AIDS began in Uganda in 1982, it is only since 1998 that ARV treatment has been officially available in the country (Ministry of Health, 2003). In the early 2000s, the government recognized the link between HIV/AIDS and poverty in the Poverty Eradication Action Plan. The goal of the plan was to provide treatment to nearly 100,000 patients by 2007 and also make ARV therapy available in all district and mission hospitals (Tumushabe, 2006). As of December 2003, there was no government subsidy for ARV treatment in Uganda (Tumushabe, 2006). Patients paid monthly fee of US $28-$60 for generic drugs and US $86 to $560 for brand name drugs. Despite these costs of treatment, by December 2003, almost 17,000 people had received treatment. Since 2004, treatment has been free of charge. Based on the statistics from the Ugandan Ministry of Health in 2005, the treatment coverage is approximately 59 %, i.e. nearly 47,000 patients remain uncovered (Kipp et al., 2009). Socio-cultural, socio-economic, and infrastructural barriers still hinder full access to treatment in Uganda.[10]

3.1.3 Kabarole district

Kabarole district, whose administrative center is the town of Fort Portal, lies in Western Uganda at the border with the Democratic Republic of Congo. As shown on the map in Appendix A2, Kabarole is divided into six counties which in turn are subdivided into 29 sub-counties.[11] Rainfall in Kabarole approaches 1200 mm per annum and mean annual temperatures range from 22 to 25 degree Celsius. However, there is a lot of variability within the district, with altitude ranges from 915 m at Lake Kyoga to 3,556 m.

[10] A wide range of sources cited by Maughan-Brown (2010) underline that stigma hinders prevention and access to treatment, and undermine the conformity of adherence to HIV/AIDS treatment.

[11] The six counties are: Bunyangabu, Burahya, Kibaale, Kitagwenda, Kyaka, and Mwenge.

As of 2002, the population of Kabarole district was 359,180 and was growing at the annual growth rate of 1.5 percent (Uganda Bureau of Statistics, 2002). There were 69,708 households in the district with an average household size of 5.08 persons (Uganda Bureau of Statistics, 2004).The Batoro, Batuku and Basongora peoples are the dominant ethnic groups (about 52%), followed by the Bakiga (28%). The remaining groups are the Bakonjo and the Bamba.

Infrastructure is not well developed in Kabarole. The district has three government hospitals namely Buhanga, Virika and Kabarole, as well as 25 health centers. The capacity in terms of the ratio of the number of inhabitants to the number of beds available is 394 persons per bed. Railway service is irregular and complements the road network, which has few links to key production areas and thus limits marketing of agricultural produce (International Food Policy Research Institute, n. d.).

3.1.3.1 Local economy

In Kabarole, average household income in 2002/03 within rural areas amounted to USh 1,366,735 with nearly 91 percent from household enterprises and 9 percent from formal employment (Uganda Bureau of Statistics, 2004).[12] Household members in Kabarole earn their livelihoods mainly from agriculture through involvement in cropping, animal rearing and/or plantation industry jobs. Nearly 90.1 percent of households own crop plots ranging from one to more than twenty plots, although the majority owns only two plots (Uganda Bureau of Statistics, 2004). Crops grown include tea, coffee, bananas, maize, Irish potato, and horticultural crops. Industrial plantations in

[12] 1 US dollar equals approximately 1998 Ugandan Shillings in August 2003.

the area focus mainly on tea. Cattle, poultry, pigs, and goats are the most common types of livestock reared by households.

3.1.3.2 HIV prevalence and AIDS treatment in Kabarole

Kabarole is in the Western region of Uganda where HIV/AIDS prevalence was 6.9 percent in 2005, i.e. 0.5 percentage points higher than the then national average (Uganda AIDS Commission, 2006). More recent studies in Fort Portal point out a higher HIV prevalence (Rubaihayo et al., 2010). Kipp et al. (2009) mention that the HIV/AIDS prevalence rate of 11% in Kabarole is one of the highest in the country. Across the district, the prevalence rate is not evenly distributed: lowest in rural areas and higher in semi-urban and urban areas (Kipp et al., 2009). Places where patients can have access to ARVs include two health centers; one of which is Rwimi, the focus of the study, and the main regional hospital in Fort Portal. Treatment is given by the Joint Clinical Research Centre (JCRC) which has a national focus and is the pioneer institution in terms of ARV treatment in Uganda.[13]

3.2 The pilot research project

The data for this study were generated as part of a community-based ARV treatment program for HIV/AIDS patients, undertaken by the University of Alberta in conjunction with the Ministry of Health, Uganda. The larger project compared urban and rural, community-based treatments. The data for this study are from households taking part in the rural community-based ARV programme. Rwimi Health Centre, one of the health centres providing ARV treatment in the district, is hosting the rural component of the project.

[13] According to Tumushabe (2006), the JCRC started ARV treatment in 1996, i.e. two years prior to the introduction of the Drugs Access Initiative pilot project by the Ministry of Health and the Joint United Nations Programme on HIV/AIDS (UNAIDS).

Patients were enrolled in the treatment programme if they matched five eligibility criteria: (1) residency in the sub-county, (2) age is eighteen years or more at the initiation of treatment, (3) treatment naivety, (4) qualification for ARVs following Uganda ARV therapy guidelines (i.e. CD4 cell count <200 cells/mm3 or World Health Organization clinical stage 3 or 4), and (5) willingness of the patient to accept daily treatment support by family/friends and to receive weekly visits from a community volunteer.

Patients were informed of the ARV program through three primary means. Employees at the health centre that were seeing patients that displayed AIDS symptoms told the patients about applying for the program. Posters were posted at and around the clinic. Finally, those who became acquainted with the project spread the news. Patients entered the program at different points in time, and as they entered the program, were subsequently interviewed quarterly over the course of one year. The earliest interview of the program was conducted on March 1, 2006 whereas the last took place on April 18, 2008. The baseline interviews (i.e. the first interviews) took place beginning March, 2006 through June, 2007.

A total of 194 patients were enrolled for the ARV treatment program at the health center. Patients willing to participate were requested to complete a permission form. Of the beginning 194 households, 163 took part in the first interview, because some patients died prior to the start of the household survey and some patients could not be located on the basis of the information they provided. The number dropped further from 163 to 134 households as the treatment progressed (Table 3.1). The 134 households that are included in this study produced a total of 670 observations over 5 visits.

Table 3.1: Variation in sample size across visits

Time reference	Number of households	Withdrawal rate (in percent)
Visit 1	163	6.7
Visit 2	152	3.9
Visit 3	146	4.8
Visit 4	139	3.4
Visit 5	134	0.0

3.3 Data collection and preparation

This study uses panel data collected with a household livelihood survey (Appendix B1) conducted among patients registered in the ARV programme in Rwimi. The survey is comprised of two main parts: (1) the baseline household survey questionnaire and (2) the quarterly survey. The baseline survey was designed to capture some basic characteristics of the household whereas the quarterly survey was designed to track seasonally other variables of interest throughout a year-long period. Quarterly surveys were administered 5 times in order to capture 1 quarter before treatment and 4 quarters after treatment began.

Enumerators administered the baseline household survey upon visiting a household for the first time after they began treatment (Figure 3.1). The baseline household survey was used to collect information on household characteristics such as household size and composition by age, gender, education, and location. This section also collected information on physical

assets (land size, housing, livestock, and durable goods), preferences regarding health service types (public, private, and traditional health services), and a standardized knowledge test about HIV/AIDS.

The quarterly survey was designed to collect data on household livelihoods. Specifically, data were collected to quantify contribution to livelihood of activities such as forestry & wild product, cropping, livestock, wage, own business, and remittances. There was a sub-section of the quarterly interview asking for time use data, which was especially directed to each of the following within the household: one adult male, one adult female, and one child aged from 10 through 15.[14] Irrespective of the household, the patient was always among the three respondents of the time use questions. Apart from the sub-sections on time-use, the questionnaire was administered to the household head or his /her representative. The same quarterly household survey questionnaire is administered in each of the visits (V1 to V5) (Figure 3.1).

[14] Household respondent's time use refers to the time she /he has spent on the day preceding the interview date on various activities.

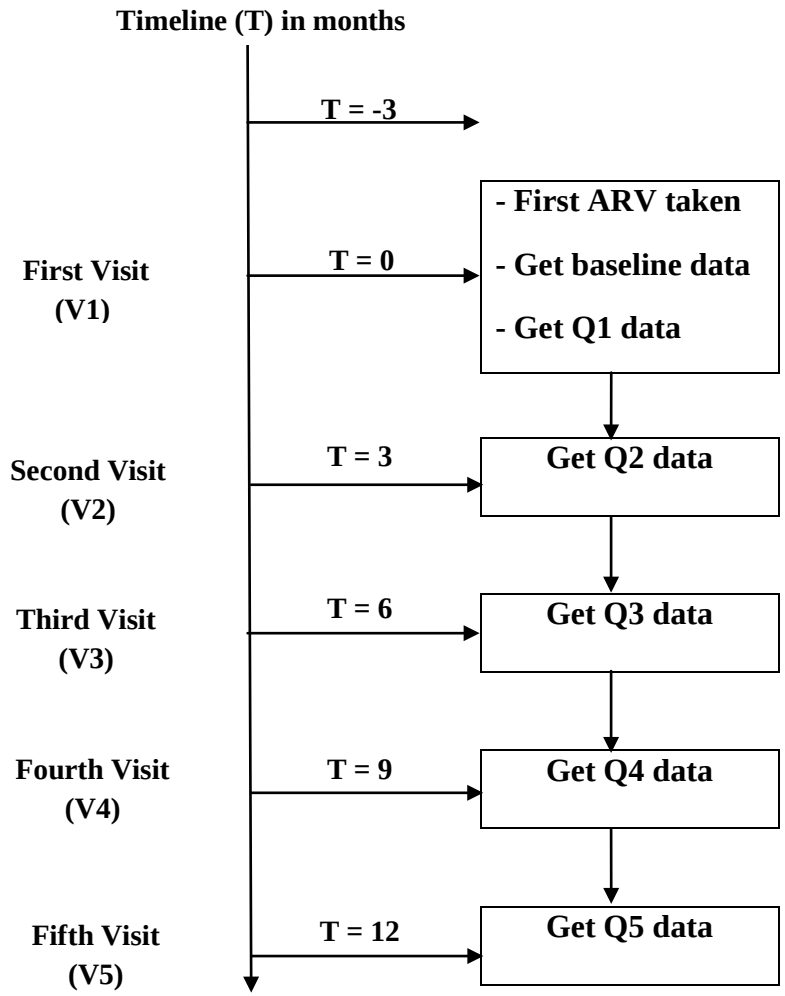


Figure 3.1: Enumerator visits for the household surveys

3.4 Construction of variables

The data collected were used to construct a number of variables for subsequent use in models.[15] There are three parts. First, we construct a measure of income. Second, we construct a wealth index. Third, we explain the process to get the knowledge score of the patient.

[15] A number of missing observations were encountered as we constructed variables. To replace missing observations, we averaged values from those visits where data was available. For example, for the three missing age of household head data, we substituted the mean from visits in which age of household head was non-missing. We also substituted the mean of expenses on productive activities for one household detected as an outlier.

3.4.1 Measures of income

In this section we explain how the household income variable, total gross income, was constructed. To proceed we consider quantities and prices of goods produced. Respondents reported all quantities of goods produced and also the quantity consumed or sold. The quantity of produced goods that are consumed represents the household's subsistence production, whereas the quantity sold represents marketed products. We use consumed and sold quantities to calculate in-kind and cash income, respectively. In-kind income is obtained by multiplying the quantity consumed at home for a given unit of sale by a price. Cash income is obtained from the multiplication of the quantity sold in the market by the household's reported price. Gross income of the household is then the sum of cash income and of in-kind income.

Data were collected on the price per unit of the goods sold as stated by the household head during visits. To calculate gross income of households with missing prices, we use the mean of the price distribution of households with non-missing prices. The survey prices are presented in Appendix B2. To deal with outliers, we experimented with trimming the distribution of prices at 5-percent and 10-percent. We ended up using the whole distribution as trimming did not affect the results.

We investigated the data to look at the normality of the distribution of the gross income variable. A normal probability plot (Appendix B3) indicates that gross income is not normally distributed. A transformation was, therefore, used to find a close distribution to the normal. Different transformations were tested using the statistical software, STATA. The graphical display revealed the log transformation could make gross income

close to normally distributed (Appendix B3). Thus, the natural logarithm of gross income was used in the subsequent model.

3.4.2 Wealth index

Principal Component Analysis (PCA) was used to compute the wealth index (*wealth)*. This index consists of five wealth characteristics whose definitions and descriptive statistics are shown in Table 3.2. The table also displays the scoring coefficients obtained from the output of the PCA model. Two factors have eigenvalues greater than 1: these two factors explain 58 percent of the five wealth characteristics' combined variance. Only factor 1, which explains the highest proportion of the five wealth index's combined variance, 33 percent, is retained as the wealth index, whereas the alternative factor 2 is dropped. Factor 1 gives most weight to household durables: both the value (*val_item*) and the breadth of household durables (*hhitems)* have the highest scoring coefficients, namely 0.575 and 0.517, respectively. The scoring coefficients are computed by assuming a regression method based on uncorrelated rotated factors. Then, after standardizing each of the five variables (Column 1) to zero mean and unit variance, the factor scores (i.e. the wealth index) are computed by weighting the variables with the scoring coefficients and summing. Details of the PCA model are shown in Appendix B4.

Table 3.2: Descriptive statistics and scoring coefficients for retained factors of the variables included in the Principal Component Analysis model

Variable	Definition	Obs	Mean	Std. Dev.	Min	Max	Factor 1 scoring coefficients
pigsbase	Total number of pigs owned within three months before the first visit	133	0.11	0.45	0	2	-0.182
val_items	Estimated total value in Uganda Shillings of household's durable goods	134	81,473.8	237,428.5	0	1,570,000	0.575
hhitems	Number of categories of household's durable goods in which a household owned at least one item	134	1.3	1.2	0	6	0.517
Homesize	Size of home in square meter	134	24.6	15.8	6	150	-0.088
Landsize	Total amount of all land types owned by the household in acres	134	4.0	5.2	0	37.07	-0.005

3.4.3 HIV/AIDS knowledge score

We compute a knowledge score (*knowaids*) following a standardized test recommended by (Kipp et al., 2009). The knowledge score is derived from the percentage of 12 Yes/No questions answered correctly. The questions test the patient's level of awareness of the basics of HIV/AIDS transmission. Of the 134 patients interviewed, the average score was 91.67 percent with a standard deviation of 9.28.

4 Chapter Four: Modeling the Effects of HIV/AIDS Treatment on Household Livelihoods

This chapter describes the empirical method used to model the effects of HIV/AIDS treatment on livelihood outcomes. We begin with the presentation of the empirical approach, along with a description of the variables used in the econometric analysis. Then, we present the estimation approach followed by a conclusion.

4.1 Empirical approach

To analyse the changes in livelihood outcomes following the onset of a HIV/AIDS treatment program, we estimate an econometric model. More precisely, we analyze whether or not, and to what extent, the treatment program affected household's income over time.

We specify the income regression for each household *i* as:

$$Y_{it} = b_0 + \boldsymbol{b}_1 * \boldsymbol{V}_i + \boldsymbol{b}_2 * \boldsymbol{T}_i + \boldsymbol{b}_3 * \boldsymbol{X}_i + e_{it} \quad (4.1)$$

where $t = 1 \ldots 5$ denotes the quarter the household was visited for the survey and t = 1 denotes the "baseline visit". *Y*, the outcome variable, denotes household gross income (in logs). **V** denotes a vector of explanatory variables denoting the treatment program, and **T** and **X** consist of both time-variant and time-invariant control variables included to help identify the effects of the treatment program on gross income.[16] The intercept term, b_o, denotes the household's income at the baseline. $\boldsymbol{b_1}$ through $\boldsymbol{b_3}$ denote the conformable

[16] Recall from the data section that *gross income* is the sum of in-kind and cash income

vectors of coefficients on the explanatory variables. The error term, e_{it}, is assumed to be independently and identically distributed and uncorrelated with the explanatory variables.

Table 4.1 contains the definitions of the variables, and their expected signs, that make up the vectors in equation 4.1. We include in **V**, four indicator variables $V_{i2,}$ $V_{i3,}$ $V_{i4,}$ and V_{i5} which denote the second through fifth program visits for household *i.* Since households are already on a downward trend in their health status when they enter the programme, and there is a time lag in recovery, we expect the coefficient on V2 to be negative. However, as households receive treatment, it is likely that their health status will improve. Therefore, we expect the coefficient on V3 through V5 to be positive.

Table 4.1: Description of independent variables and expected signs

Variable name	Description	Expected sign
Second program visit (*V2*)	Dummy variable taking the value 1 if the household completed the first three-month period under ARVs and 0 if not.	-
Third program visit (*V3*)	Dummy variable taking the value 1 if the household completed the second three-month period under ARVs and 0 if not.	+
Fourth program visit (*V4*)	Dummy variable taking the value 1 if the household completed the third three-month period under ARVs and 0 if not.	+
Fifth program visit (*V5*)	Dummy variable taking the value 1 if household completed the fourth (or last) three-month period of the program and 0 if not.	+
Time trend ($trend\_time_t$)	Time count variable, from 1 to 10, numbering sequentially the quarters of the year, indicating when each household started the program. The value '1' equals first quarter of 2006, while '10' equals second quarter of 2008.	+/-
Short rainy season (*SQ2*)	Dummy variable equal to 1 if the visit occurs in the short rainy season, i.e. within the last quarter of the year, and 0 otherwise. It is compared to other seasons of the year.	+/-
Age of household head (*agehead*)	Age of household head in years.	+
Average household education per adult member (*aveducad*)	Average years of education per adult living in the household. It is obtained by dividing the total of years of education obtained by all adults in the household.	+

Table 4.1: Description of independent variables and expected signs

(Continued)

Number of household adults (*hhadult*)	Number of household adults including any dweller aged from 10 to 65 years.	+
Number of household dependents (*hhdep*)	Number of household dependents including any dweller aged from 0 to less than10 years and those aged above 65 years.	-
Household wealth index (*wealth*)	Household's wealth index from -1.399 to 5.073 that includes: pig size prior to first visit, market value of durables, count of durables, home size, and land size.	+/-
Household's quarterly expenses on productive activities (exp_activs_t)	Household's expenses on income-generating activities expressed in thousands of USh.	+
The patient is the household head's spouse (*patispouse)*	Dummy variable taking the value 1 if patient is household head's spouse and 0 otherwise.	+/-
The patient's gender is female (*patfemale)*	Dummy variable taking the value 1 if patient's gender is female and 0 otherwise.	+/-
Kabale (*kabale*)	Regional dummy variable taking the value 1 if the household is in Kabale and 0 otherwise.	+/-
Kaina (*kaina*)	Regional dummy variable taking the value 1 if the household is in Kaina and 0 otherwise.	+/-
Knowledge score of the patient (*knowaids*)	Knowledge score of the patient reported on a 100-scale. It is the sum of correct answers out of twelve possible and expressed in percent (i.e. times 100 divided by 12).	+

We include in **T** two control variables – a time trend (*trend_time)* and seasonality (*SQ2*). The time trend captures the effects of the fluctuations in the macro-economic environment variables that are not solely attributable to random factors, such as changes in overall demand and supply conditions, technological change, change in taste and preference of consumers, an epidemic disease outbreak, on households' gross incomes. We have no expected signs of the time trend variables. The seasonality variable denotes the onset of the short rainy season, which falls within the last quarter of the year. According to the literature reviewed in Chapter 2, crop demand and input purchases in subsistence economies may be seasonal. We have no expected sign for the seasonality variable.

The control variables included in **X** consist of five groups. First, socio-demographic variables including age of household head (*agehead),* average education of adult household members *(aveducad),* number of household adults (*hhadult),* and number of household dependents *(hhdep)*. Second, socio-economic variables including household wealth index *(wealth)* and expenditure on activities (exp_activs_t). Third, patient characteristic variables including whether the patient is the household head's spouse *(patispouse) and* patient's gender (*patfemale)*. Fourth, geographic effects variables including regional dummies for Kabale *(kabale)* and for Kaina (*kaina)*. Fifth, a disease awareness variable includes the patient's knowledge score *(knowaids)*.

Regarding socio-demographic characteristics, recall from the literature review, Chapter 2, that the effect of the household head's age on income could be positive up to a certain amount. In this sample our household heads are generally of ages where we expect to have a positive relationship at an average of 43 years. Higher educational levels can lead to more income through various channels (Chapter 2) and we expect the effects of education on income to be positive. The greater the number of working adults,[17] in the household, the higher the chances of having potential people who can work for more income. Despite the fact that there are some mixed results in the literature (Chapter 2), numerous studies find a positive impact of the number of adults living in the household on income, which we anticipate finding in our sample. The number of household dependents can be an extra burden to the household in terms of more mouths to feed or more school fees to spend, thereby reducing income. Despite the fact that there are some exceptions in the literature, most studies find that more dependents in the household reduce income. We expect the effect of household dependents on income to be negative.

We also expect wealth to influence income. Recall from the literature review, Chapter 2, that the more wealth the household has, the higher income is expected to be. However, in households with HIV/AIDS, we could also see households reducing wealth in order to create income by selling off assets. Therefore, the sign on the wealth variable may be positive or negative. Regarding the variable quarterly expenses on productive activities, production

[17] The number of working adults is referring to people who are potential workforce participants. Following Tschirley and Weber (1994) the number of household adults includes any dweller aged from 10 to 65 years, whereas household dependents include dwellers aged from 0 to less than10 years and those aged above 65 years.

theory supports that more expenses on inputs of production lead to more income. We expect quarterly expenses on productive activities to have a positive effect on gross income.

The group of patient characteristics - patient is household head's spouse and patient's gender may affect household income as well. We are interested in seeing whether the spouse of the household head is more important to the production activities of the household than household members who are not. Recall from the literature, Chapter 2, that whether the HIV/AIDS patient is male or female may also matter, but we have no expectation regarding the signs.

Geographic effects are represented by parishes. We began by including the dummy variables for all of the 10 parishes in the region. However, we subsequently eliminated all parishes that were not significant. In Table 4.1 we only include parishes that were significant, whereas the baseline refers to all the remaining ones.

The sign on the knowledge of HIV/AIDS variable is expected to be positive. As discussed in Chapter 2, the more knowledge an individual under treatment has about HIV/AIDS, the better choices she/he can make regarding treatment.

4.2 Estimation approaches

To estimate the model described, we use one variety of robust regression: the iteratively reweighted least square (IRLS). The IRLS provides notable resistance to Y-outliers, if the observations with unusual values of the dependent variable do not contain unusual values of the explanatory variables.

The IRLS estimator also provides the level of efficiency that is better than ordinary least square (OLS) in the presence of non-normal, heavy-tailed error distributions (Hamilton, 1991; Anderson, 2008). Both IRLS and OLS belong to the family of unbiased estimators. The rest of this section has two parts. First, we conduct a graphical test to ascertain whether OLS should be rejected in favour of the IRLS estimator. Second, we describe the IRLS regression process.

4.2.1 Choice of the IRLS estimator

The non-normal distribution of errors in the dependent variable *Y* supports the use of a robust regression estimator, i.e. IRLS, in this study. Figure 4.1 displays the distributional diagnostic plot of the dependent variables *Y*. Quantile-normal plots focus on the tails of the distribution to measure the ability of the residuals to conform to a reference normal distribution.[18] If the residuals of *Y* were normally distributed, the residual plots would match perfectly with the 45-degree line of the quantile-normal plot. It is rather not the case in the figure, which calls for the rejection of OLS in favour of a robust regression estimator.

[18] This is to be contrasted with the probability plots that emphasize instead the middle of the distribution. Using probability plots did not contradict the results of the test via quantile-normal plots.

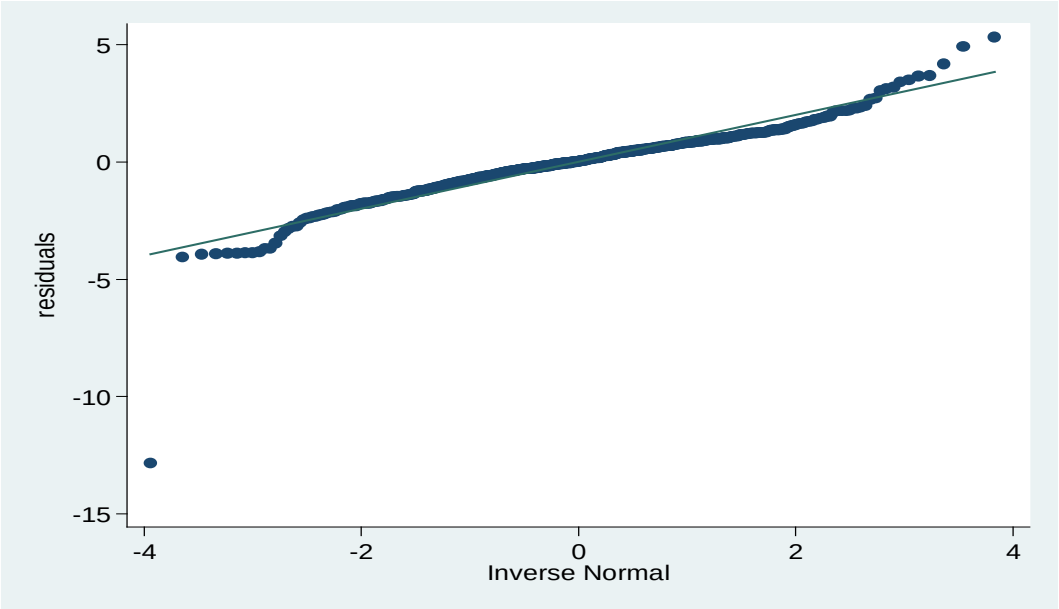


Figure 4.1: Quantile-normal plot for residuals in the income regression

4.2.2 IRLS regression

The IRLS procedure involves two steps: calculation of case weights based on absolute residuals and then regression using the calculated weights. IRLS uses two types of weight functions: Huber weighting and biweights. This use of two different weightings complements each other. The Huber weights do not well control severe outliers at the difference of biweights, whereas biweights do not always converge or generate multiple solutions at the difference of Huber weights (Hamilton, 1991).

5 Chapter Five: Impact of HIV/AIDS Treatment on Livelihoods

This chapter presents the results of analyzing the impacts of a rural community-based ARV treatment program on the livelihoods of HIV/AIDS patients' households. The livelihood measure used is income. There are three sections. First, we show the characteristics of the livelihood portfolios of households in terms of income and time-use (objective 1 from Chapter 1). Second, we provide a description of the main variables to be used in the regression model. Third, we present an econometric analysis of the performance of households under the ARV treatment in terms of their gross income (objective 2 from Chapter 1).

5.1 Household livelihood portfolio characteristics

5.1.1 Household incomes

In order to evaluate the success of ARV treatment, it is important to have an understanding of the variation in income from one visit to the next over the period of the program. Figure 5.1 displays the quarterly gross income of ARV recipient households in our sample from the baseline (V1) through the last program visit (V5). The descriptive statistics in the figure show the incomes of the whole sample and of two subsets of the sample. Considering the whole sample (the middle line in Figure 5.1), the gross income (in millions of USh) of households increased, on average, from 0.39 at the baseline to 0.85 at the last program visit. Households in our sample consist of 53% of households whose income increased (increasing households, henceforth) and 47% of

households whose income dropped (decreasing households, henceforth). Based on the steepness of the lines, we notice that, on average, the decreasing households are losing less than the increasing households are gaining. Interestingly, decreasing households started off with a higher average income at the baseline visit, although incomes of the increasing households become greater after V2.

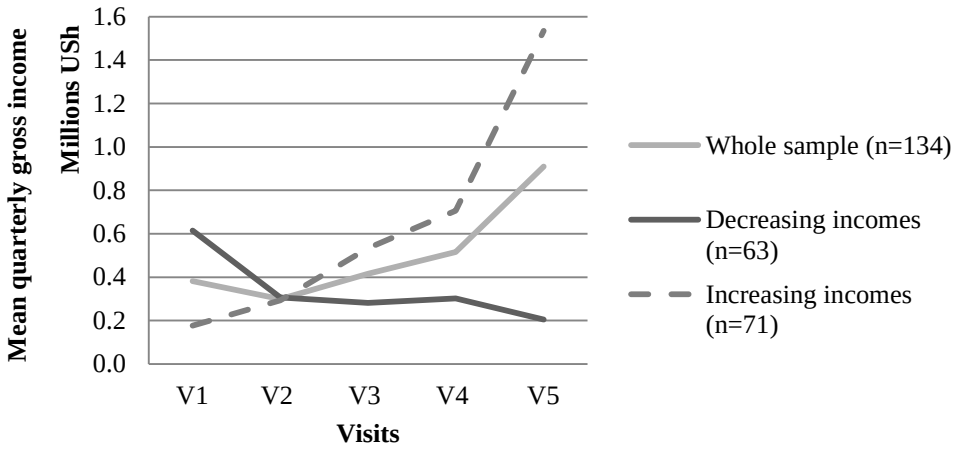


Figure 5.1: Average gross income of households across visits

The differing results between increasing and decreasing households are unexpected. For this sample of households, Alibhai et al. (2010a) have shown that virtually all patients achieved virological suppression and health related quality of life outcomes. We investigate differences between increasing and decreasing households further in subsequent sections.

Figure 5.2 shows how the increasing and the decreasing households are spread across the distribution of households, ordered by wealth data collected in the baseline visit. Household wealth is measured by an index (see Chapter 3) and ordered from the poorest to the wealthiest along the X-axis. Visually, there is no obvious pattern regarding whether increasing or decreasing households are wealthier. On average, increasing households have a wealth

index measure of -0.107 (standard deviation 0.830) while decreasing households have a measure of 0.119 (standard deviation 1.160) but these differences are not significant at the 5% level.

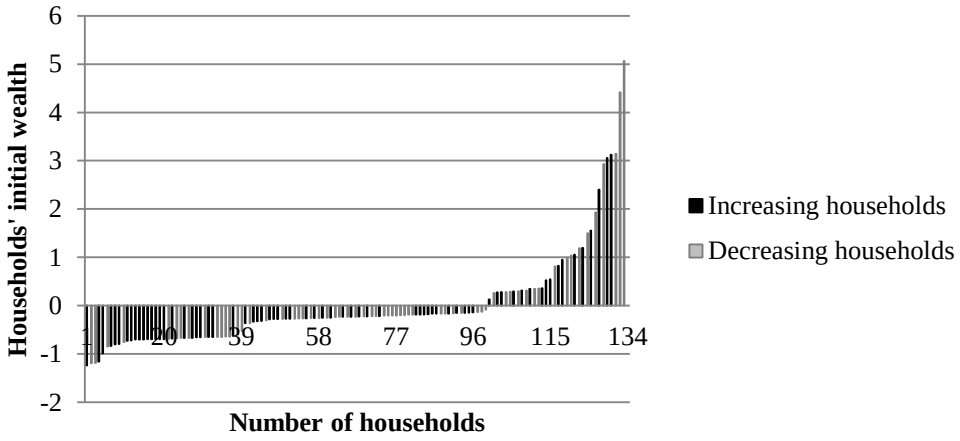
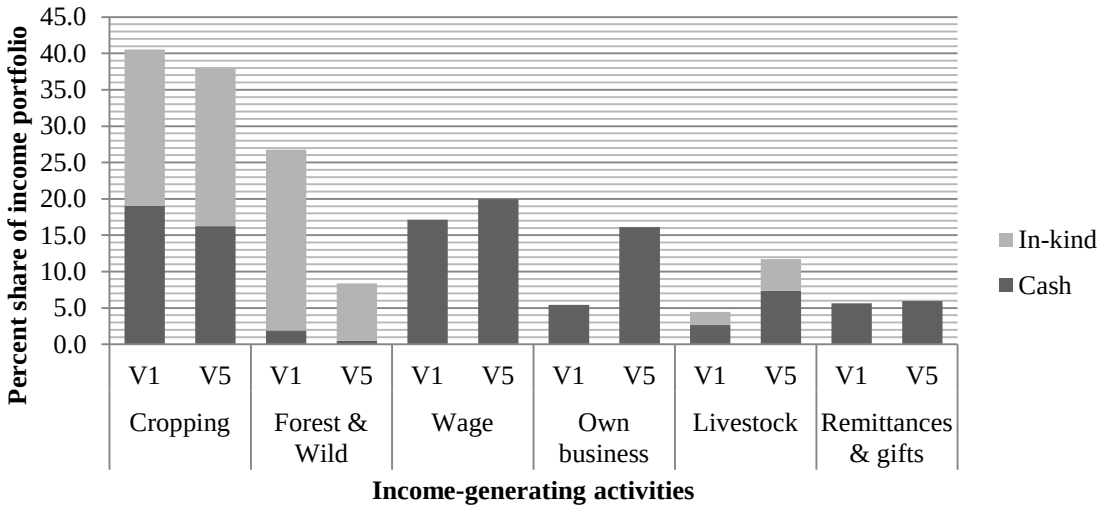


Figure 5.2: Increasing and Decreasing households across the distribution of households ordered by wealth

5.1.2 Households' income portfolios

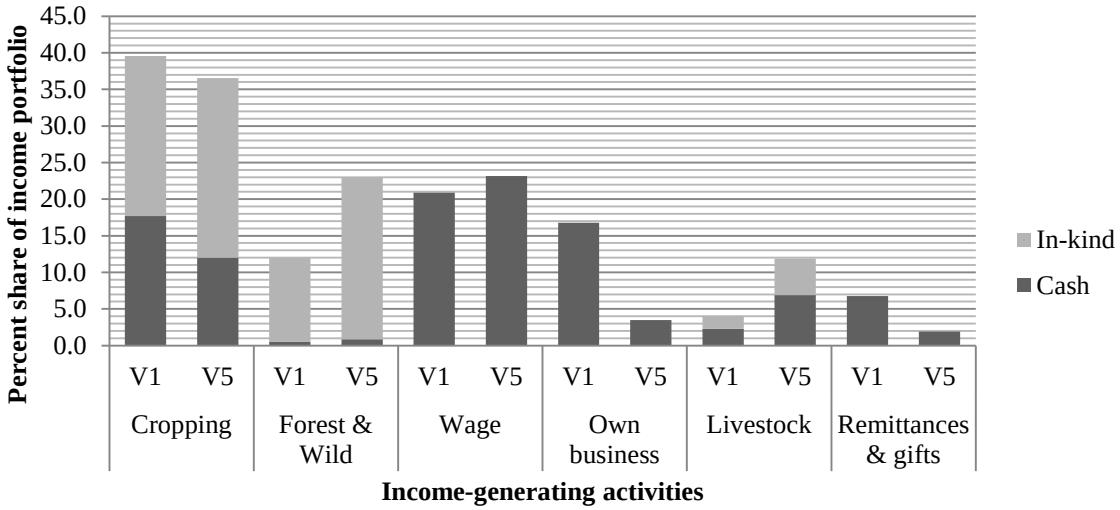
Households in our sample, on average, have a diverse and time-variant income portfolio. Figure 5.3a shows the average portfolios of increasing households, while Figure 5.3b shows the average portfolio of decreasing households. The two figures disclose similarities regarding the shares of income from cropping, wage employment, and livestock rearing. For both types of households, cropping makes up more than a third of the income portfolio, followed by forest & wild, made up largely of subsistence incomes. However, there are three notable differences between the income portfolios of increasing and decreasing households. First, the share of income from forest & wild drops among increasing households between V1 and V5. In contrast, among the decreasing households, income shares from forest & wild increases.

Second, the share of own business income for the increasing households triples, while decreasing households see their business income drop by more than two-thirds. Third, remittances & gifts slightly increase across visits during the program among the increasing households, while for the decreasing households this income falls.



Note: V1 = First Program Visit; V5 = Fifth Program Visit

Figure 5.3a: Variations across visits of in-cash vs. in-kind shares by sectors of activities (in percent) –increasing households



Note: V1 = First Program Visit; V5 = Fifth Program Visit

Figure 5.3b: Variations across visits of in-cash vs. in-kind shares by sectors of activities (in percent) –decreasing households

5.1.3 Time use portfolios

Figure 5.4a and Figure 5.4b show income-generating time use arranged by sectors of activities and by household gender and age categories. The figures show that key differences between the increasing and the decreasing households lie in children's time use. For increasing households, children spend most of their time on livestock. For decreasing households, children spend less time on livestock, and adult males spend more time. Overall income from livestock does not differ much between increasing and decreasing households (Figure 5.3a and 5.3b). Therefore, it appears as though there is a substitution of adult labour for child labour in this sector. Another key difference is with respect to the time use of children in forests & wild. Recall from Figures 5.3a and 5.3b, that increasing households reduce forests & wild income across visits, while decreasing households increase forests & wild income across visits. In Figures 5.4a and 5.4b, we see that children are the likely source of this increased income as children from increasing households spend little time on forest & wild activities, while children in decreasing households spend much more time. Finally, in the business sector, there is also a difference in the allocation of children's time between increasing and decreasing households. Recall again that in Figures 5.3a and 5.3b, the own business income of increasing households increased, while the business income of decreasing households decreased. Figures 5.4a and 5.4b show that as households decrease their business income, children play a larger role in contributing time to this activity.

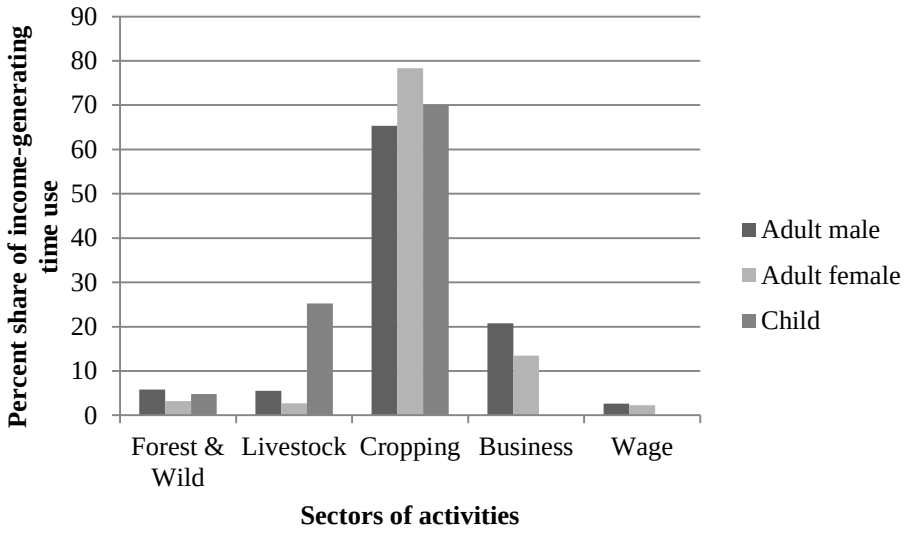


Figure 5.4a: Sectoral time use in income-generating activities by adult gender and by age category (mean percentage in the category) – increasing households

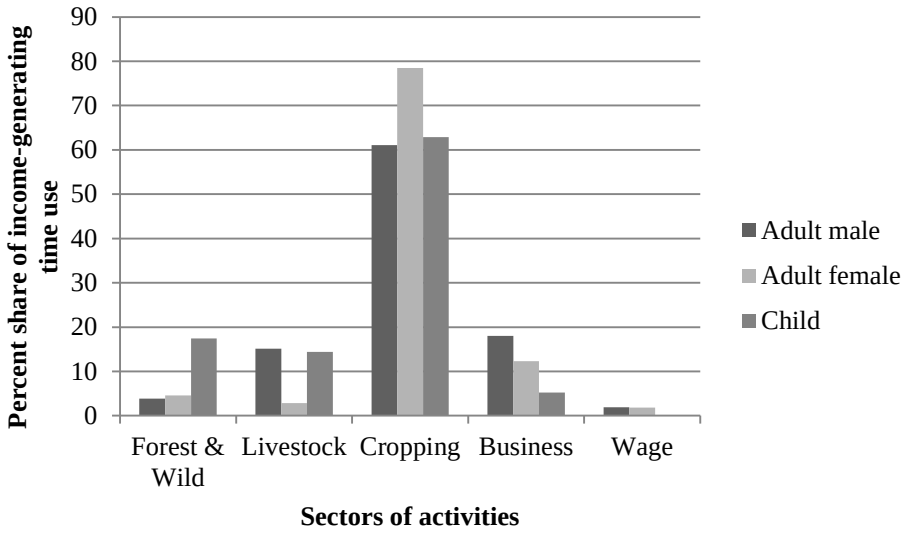


Figure 5.4b: Sectoral time use in income-generating activities by adult gender and by age category (mean percentage in the category) – decreasing households

5.2 Descriptive statistics of variables used in regressions

Table 5.1 shows the descriptive statistics of the dependent and independent variables involved in the econometric analysis to be described in the next section. We group the independent variables into two categories, namely the program variables and the control variables. The former refer to income at specific periods during the program. The latter help to control for possible confounding factors. Among the control variables, we include an increasing households' dummy variable (0=decreasing income, 1=increasing income) to account for the differences between these two categories.

Control variables also include important household socio-demographic, socio-economic, and geographic characteristics. Data on the average education of adult household members reveal a general low level (1.3 years) of education. The mean age of household heads of nearly 43 years indicates that most of them are likely to be of working age. Of all the households in our sample, 19.7 percent are from Kabale and 9.4 percent from Kaina. The table also shows that there are, on average, more adults in households than dependents. The table also indicates a mean of expenses on activities of 61 thousand USh (approximately 27 US dollars), which represent 13 percent of household income. The deviation around the mean expenses on productive activities is about 4 times the mean value.

Table 5.1: Descriptive statistics of explanatory variables (N=670)

Variables*	Mean	Std dev.	Min	Max
Dependent variable				
Natural log of household's gross income	12.095	1.300	8.161	17.842
Explanatory variables				
Control variables				
Increasing households' dummy (0=decreasing, 1=increasing) (*idum*)	0.53	0.499	0	1
Time trend ($trend\_time_t$)	5.47	2.178	1	10
Average household education per adult member (*aveducad*)	1.28	1.436	0	13
Age of household head (*agehead*)	42.74	11.599	22	77
Number of household adults (*hhadult*)	3.66	1.998	1	11
Number of household dependents (*hhdep*)	1.24	1.230	0	5
Knowledge score of the patient (*knowaids*)	91.67	9.282	58.33	100
Household wealth index (*wealth*)	0.00	1.000	-1.399	5.073
Short rainy season (*SQ2*)(within October-December period)	0.20	0.399	0	1
Kabale parish (*kabale*)	0.19	0.396	0	1
Kaina parish (*kaina*)	0.10	0.296	0	1
Household's quarterly expenses on productive activities (exp_activs_t)	61.54	239.847	0	3000
Program variables				
Second program visit (V2)	0.20	0.400	0	1
Third program visit (V3)	0.20	0.400	0	1
Fourth program visit (V4)	0.20	0.400	0	1
Fifth program visit (V5)	0.20	0.400	0	1

*The definition of variables is given in Table 4.1 except for the increasing households' dummy.

5.3 Income regression on impact of HIV/AIDS treatment

Results of previous sections suggest that there are important differences in the impacts of ARVs on income between increasing and the decreasing households. Therefore, in addition to the specification in Chapter 4, we include the increasing households' dummy (*idum*) as a control variable. We also investigate interactions between the increasing households' dummy variable and other explanatory variables. In the model presented below, interactions were dropped if they were highly insignificant.

Table 5.2 shows the results of the estimated regression.[19] The model has overall significance at less than a one percent level. The R-squared of the model is 0.27. The constant value stands for the logged income value at the baseline and is highly significant. The baseline is composed of income in the first visit (V1) for the decreasing households not living in Kabale or in Kaina, and not during the short rainy season. We make all comparisons for the two household categories relative to this common baseline. The coefficient on the increasing households' dummy variable indicates that increasing households started off at a lower level of income at V1- almost 124 percent lower according to our estimates compared to the baseline group. This is consistent with the pattern of relative incomes observed for the two groups of households in Figure 5.1.

[19] We have also estimated the OLS version of the robust regression model. The results are qualitatively and quantitatively equivalent. They can be made available upon request. In addition, we have checked for heteroskedasticity using Breusch-Pagan/Cook-Weisberg test. The null hypothesis of constant variance could not be rejected at the 10 percent level of significance.

Table 5.2: Results of the income regression

Dependent variable: log of gross income	
Independent variables	Parameters
Constant	11.82068***
	(0.489)
Control variables	
Increasing households' dummy (0=decreasing, 1=increasing) (*idum*)	-1.23831***
	(0.206)
Time trend ($trend\_time_t$)	0.01636
	(0.028)
Number of household adults (*hhadult*)	0.09188***
	(0.026)
Number of household dependents (*hhdep*)	0.09004**
	(0.035)
Knowledge score of the patient (*knowaids*)	0.01192***
	(0.005)
Household's expenses on productive activities (exp_activs_t)	0.00096***
	(0.000)
Short rainy season (*SQ2)*	-0.33620***
	(0.106)
Age of household head (*agehead*)	-0.01134***
	(0.004)
Kabale (*kabale*)	-0.32513***
	(0.113)
Kaina (*kaina*)	-0.27975*
	(0.144)
Household wealth index (*wealth*)	0.19299***
	(0.056)
Increasing households * Household wealth index	-0.15975*
	(0.087)
Average household education per adult member (*aveducad*)	-0.09543
	(0.065)
Increasing households * average household education per adult member	0.19050***
	(0.071)
Program variables	
Increasing households * V2	1.25721***
	(0.259)
Increasing households * V3	1.51182***
	(0.260)
Increasing households * V4	1.51412***
	(0.260)
Increasing households * V5	2.08160***
	(0.261)

Table 5.2: Results of the income regression

(continued)

Second program visit (*V2*)	-0.83414***
	(0.191)
Third program visit (*V3*)	-1.02753***
	(0.198)
Fourth program visit (*V4*)	-1.00004***
	(0.208)
Fifth program visit (*V5*)	-1.11681***
	(0.224)
Observations	670
R-squared	0.272

Standard errors are in parentheses below the regression coefficients.

The interactions between two variables are indicated by *.

Significance level of 0.01, 0.05, and 0.1 are indicated by *, **, and ***, respectively.

Note: The definition of variables is given in Table 4.1 except for the increasing households' dummy.

All the control variables appear significant except for the time trend and the average education per adult household member for decreasing households. The insignificance of the time trend variable suggests that it does not matter what time of the year households in our sample started the programme. The education variable and its interaction with increasing households will be discussed together later in this section. We also discuss wealth and its interactions with increasing households at the same time.

Control variables that are not expected to differentially impact the two types of households appear without interactions terms in Table 5.2. Several among this set of controls are found to positively impact income: the number of household adults, the number of household dependents, the HIV/AIDS knowledge score of the patient, and household's expenses on productive activities. Both the number of household adults and the number of household dependents raise income by about 10 percent. Having more working adults in

one household is a plus because they can work, thereby positively influencing monthly gross income. In contrast, our expectation was that the number of dependents would decrease income. Instead it appears as though dependents are contributing to income as suggested by early results in Figures 5.4a and b which show the importance of children's time in a number of income generating activities.

Some of the control variables from the above sets are also associated with decreases in income from V2 through V5. First, the short rainy season of the year, rather than the other seasons of the year, decreases income by 33.6 percent relative to the baseline. Second, the age of the household head pulls down income in the fifth program visit by 1.2 percent. The negative sign on age of the household head is not consistent with our expectations, as we expected older household heads to be receiving more income. However, recall that the average age of household head is 43 years (Table 5.1). This suggests that there are a large number of fairly mature household heads who may be past their prime income earning years. Third, residence in the geographical parishes of Kabale or Kaina vs. any other parish, decreases income. Households in these parishes receive lower amounts of remittances and gifts relative to other households in the sample. Compared to the overall sample, households in Kabale and Kaina receive nearly 50 and 30 percent fewer remittances & gifts, respectively.

We now turn to discussion of control variables that are interacted with the increasing household dummy. The coefficient on the household's wealth index variable is positive and significant. This suggests that if a decreasing household had higher initial wealth it would face less of a decrease in income

during the program. We estimate that 1 unit increase in wealth leads to a 19.3 percent increase in income of decreasing households. The interacted wealth index variable, which captures the differential wealth impact for increasing households, is negative and significant. Comparing its magnitude to the wealth effect for decreasing households (i.e. subtracting 16 from 19.3 percent), we estimate that 1 unit increase in wealth leads to approximately a 3 percent increase in income of increasing households. We also find that average education contributes significantly to the income of increasing households. A 1 unit increase in average education results in a 19 percent increase in income of increasing households during the program period. The effect of average education per adult household member is insignificant for decreasing households.

Given the effect of the control variables, we now turn to examining the performance of households in terms of their income during the program period. To do so we look at the estimated coefficients on the variables V2-V5 and their interactions with the increasing household dummy in Table 5.2. The magnitude of the coefficient on a visit variable V2, for example, represents the percent change in income faced by decreasing households in V2 relative to baseline conditions in V1. The corresponding number for increasing households is obtained by adding the coefficient on the interaction term idum*V2 to the above effect.

The results show that the impacts of the community-based ARV therapy program on income across all visits are positive among the increasing households and negative among the decreasing households. We find that the income for decreasing households fell steadily throughout the program period.

The amounts of decrease during V2-V5 were -83, -103, -100, -112 percent, respectively. In contrast, the income for increasing households increased steadily and accelerated during the program period. The amounts of increase were 42, 48, 52, 96 percent for V2-V5, respectively. These results suggest that ARVs have, overall, boosted income of a majority households in our sample with its salutary effects disproportionately felt among the poor.

6 Chapter Six: Concluding Remarks

In the introductory chapter, we stated that the objectives of this study were to characterise the livelihood portfolios of households and to examine incomes across program visits. This closing chapter presents our concluding remarks regarding the impacts of ARVs on the livelihoods of HIV/AIDS patients and their households. We start by summarizing the study and its results. We then provide some policy implications, limitations, and recommendations for further research.

6.1.1 Summary

This study examines the livelihoods effects of ARVs on HIV/AIDS patients' households. We use a panel data set collected from a sample of households infected with HIV/AIDS under a community-based ARV therapy programme in the rural area of Kabarole district, Uganda. We find that ARV therapy has positive impacts on the income of households in our sample. Incomes of ARV households improve, on average, over the treatment period by 59.5 percent. This amount is much higher than the 10% increase found by Chhagan et al. (2008) in South Africa (see chapter 2), where the increase included social grants. However, for 53 percent of households incomes are increasing, while for 47 percent incomes are decreasing.

Notable traits characterise the increasing and the decreasing households with respect to their portfolios and treatment impacts on income. Regarding income and time use portfolios, three points are noteworthy. First, over the program period, the increasing households earn more income from business

and from remittances & gifts, while the decreasing households draw their income from forest & wild. Second, both livestock and wage income increase during the program regardless of whether households are increasing or decreasing. Third, children's time use appears to differ between increasing and decreasing households. Children's time use improves income from livestock among the increasing households and income from forest & wild among the decreasing households.

The impacts of ARVs on incomes across treatment periods are positive among the increasing households and negative among the decreasing households, after controlling for household socio-economic and environment characteristics. Average household education per adult member increases income of increasing households. Initial wealth increases income of ARV recipients' households regardless of whether they are increasing or decreasing. The benefits of having higher initial wealth are about five times greater among decreasing households than their increasing counterparts. Residence in Kabale and Kaina, rather than in any other location, has negative effects on income across program periods relative to the baseline.

6.1.2 Policy implications

The results of our study indicate that households in our sample received increases in income that averaged approximately 60 percent. Moreover, a number of conditions were shown to be complementary to ARV treatments. We emphasize these in the policy implications listed below.

i. This study suggests that asset poverty can be a threat to recovery from HIV/AIDS, as lower wealth levels reduce income of ARV households. Poor people seem to be more difficult to help. Therefore, ARV therapy programs could potentially benefit by being jointly implemented with pro-poor development programs.

ii. Study results hold that education is a significant contributor to incomes of increasing households. This means that having more investment in human capital helps households recover. One policy implication at the micro level is to create favourable conditions for completion of primary education and ease of access to secondary education. For households of HIV/AIDS patients on treatment in particular, social programs designed to support children education could counter school dropout rates.

iii. This study points out the importance of business income among households whose income improved over the program period. Amid communities in which the ARV therapy program is being implemented, the government may consider facilitating the creation, control, and evaluation of incentive programs to support small-scale off-farm businesses. An example could be a program for the creation of improved small-scale processing and marketing enterprises.

iv. Income from livestock has also increased during ARV treatment. Perhaps households are in an asset rebuilding phase following the disposal of assets undergone during the period of intense illness. This recuperating behaviour may be the best option available to households. Accordingly, providing support to this sector in terms of extension and veterinary services may be advisable.

v. Results suggest that children's role in providing labour is a potentially big factor in differentiating between increasing and decreasing households. The increased role of children in forest & wild among decreasing households can be considered a sign of desperation. Development programs that focus on children's welfare may be important.

6.1.3 Limitations

More research needs to be done to probe into the underlying reasons why some households experience negative growth rates, although on average the sample households under treatment increase their welfare. The availability of panel data over multiple years could help further isolate unobserved household specific factors that can potentially cause different groups of households to follow different recovery paths in terms of income. Deeper insights into the differences between the increasing and decreasing households can also be gleaned if changes in income are examined over a long period of time. For instance, the current study considers consecutive quarterly visits to each household for only one year. This approach does not pick up changes in income due to adoption of new technologies over the long term. Studies have shown that there might be changes in the activities contributing to livelihoods

as time elapses following treatment (Campbell et al., 2002). However, the 1-year study of our sample is not unusual compared to most existing studies dealing with the effects of ARVs on household characteristics, which often do not span over a year (Beard et al., 2009).

Our study also does not capture changes in wealth over time (such as sales of livestock assets) or investments that can create different streams of household income but with potentially different outcomes in the short and the long term. Currently, we cannot establish whether some households are spending more on assets and/or activities that generate higher incomes in the long run, while causing a dip in their income in the short run. For example, a household may invest in a coffee plantation by putting together funds from various sources including saving more from current income and reduced current consumption. The returns from the investment will likely accrue over time. This could be a potential profile for a decreasing household in our sample – however, current data limitations prevent us from establishing such theories in an empirically sound manner.

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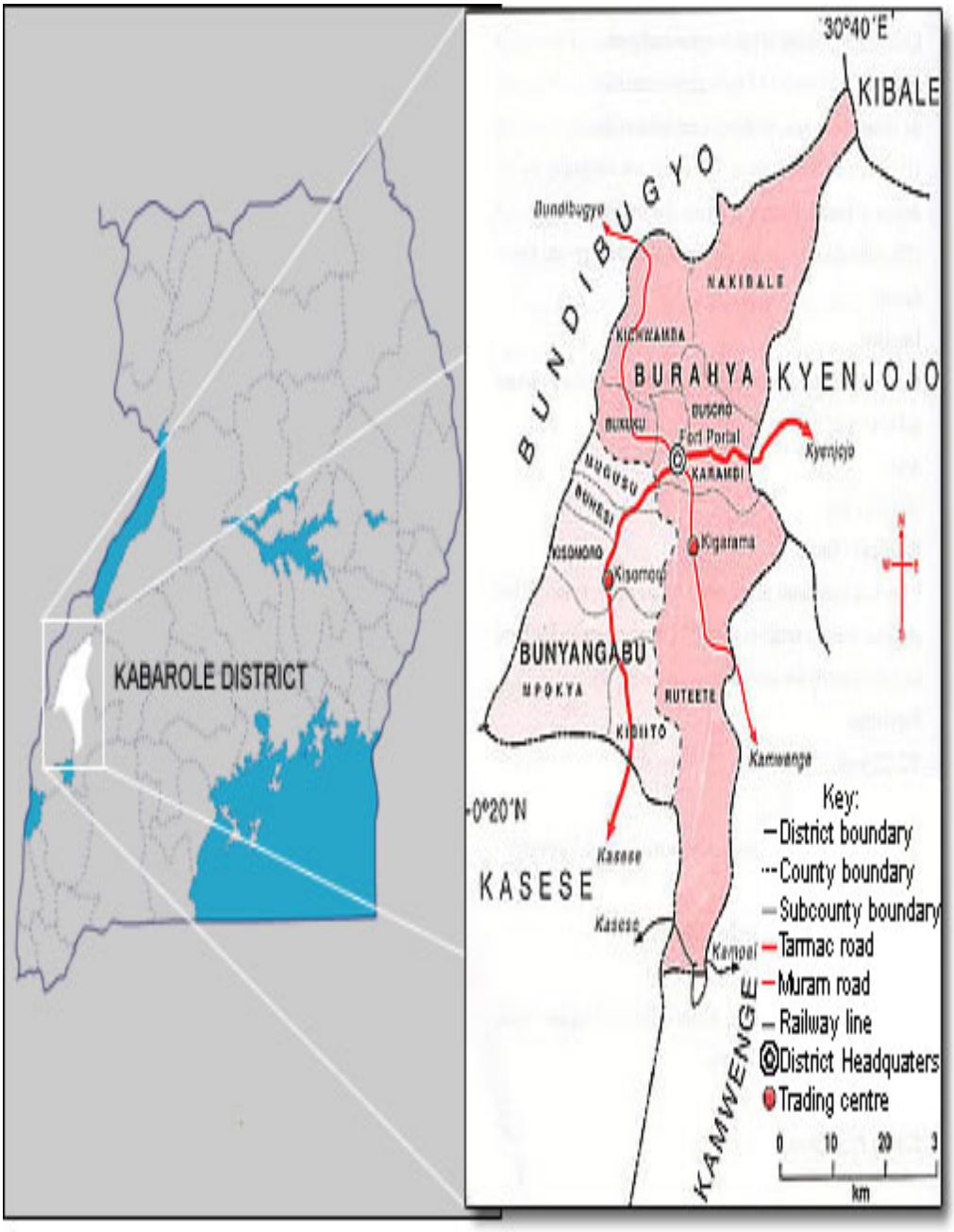
Appendix A1: Map of Uganda

Source: http://commons.wikimedia.org/wiki/Atlas_of_Uganda

Appendix A2: Map of Kabarole District



Source: Kabarole District Information Portal, 2007

Appendix B1: Household livelihood questionnaire

Patient Survey

Dialogue for the enumerator

(Enumerators will approach the residence, and will ask to speak with the head of the household when the door is opened)

-Good morning (afternoon), my name is… and I am a researcher with the Kabarole Research Centre in Fort Portal. I am here as part of the ARV study in which your household is participating. As you were told during your registration in the program, we are here to ask a number of questions about your household's activities. We are hoping we can spend about one hour speaking with you and members of your household. Is now a good time to speak with you?

(On subsequent visits: Say 45 minutes instead of one hour)

(If No:) May we come again at another time? (Record date and thank them for their time)

(If yes:) Thank you. (Proceed to survey)

Baseline household survey 1 (A1)

Control information

Task	**Date(s)**	**By who?**	**Status OK? If not, give comments**
Interview			
Checking questionnaire			
Coding questionnaire			
Entering data			
Checking & approving data entry			

A. Identification

1. Identification and location of household.

1. Household number		
2. Village	**(name)*	*(village ##)*
3. Name and PID (see B. below) of household head	**(name)*	*(PID)*

B. Household composition

1. Who are the members of the household [Who regularly takes their meals together]?

1. Personal Identification number (PID)	*** Name of household member**	**2. Relation to household head[1)]**	**3. Year born** *(yyyy)*	**4. Sex** *(**m**ale or **f**emale)*	**5. Education** *(number of years completed)*
1		Household head			
2					
3					
4					

5					
6					
7					
8					
9					
10					
11					
12					
13					
14					

1) Codes: 1=spouse; 2 son/daughter; 3=son/daughter in law; 4=grandchild; 5=mother/father; 6=mother/father in law; 7=brother or sister; 8=brother/sister in law; 9=uncle/aunt; 10=nephew/niece; 11=step/foster child; 12=other family; 13=not related.

1) Codes: 1=spouse; 2 son/daughter; 3=son/daughter in law; 4=grandchild; 5=mother/father; 6=mother/father in law; 7=brother or sister; 8=brother/sister in law; 9=uncle/aunt; 10=nephew/niece; 11=step/foster child; 12=other family; 13=not related.

6. What is the marital status of household head? *Codes: 1=married and living together; 2=married but spouse working away; 3=widow/widower; 4=divorced;; 5=never married; 9=other, specify:*	

C. Land

1. Please indicate the amount of land (and specify the units) that you currently own and have rented in or out.

Category *Note: see definitions of land categories in definition sheet*	**1. Area** *circle one:* *ha / acre*	**Main crops grown and/or harvested in the past 12 months Max 3** *(code-products)*		
		2. Rank1	**3. Rank2**	**4. Rank3**
1. Natural forest				
2. Managed forests				
3. Plantations				
4. Cropland				
5. Pasture (natural or planted)				
6. Agroforestry				
7. Silvi-pasture				
8. Fallow				
999. Other vegetation types/land uses (residential, bush, grassland, wetland, etc.)				
10. Total land owned (1+2+3+…+9)				
11. Land rented out (included in 1-9)				
12. Land rented in (not included in 1-9)				

D. Assets and savings

Note: These questions refer to the primary dwelling of the household.

1. Ownership of home (see codes below in note 1).	
2. What is the type of material of (most of) the walls? [2)]	
3. What is the type of material of (most of) the roof ? [3)]	
4. Approximate size of home (in square meters).	m^2

1) Codes: 0=do not have own home; 1=own the house on their own; 2=own the house together with other household(s); 3=renting the house alone; 4=renting the house with other household(s); 9=other, specify:

2) Codes: 1=mud/soil; 2=wooden (boards); 3=iron (or other metal) sheets; 4=bricks or concrete; 9=other, specify:

3) Codes: 1=thatch; 2=wooden (boards); 3=iron or other metal sheets; 4=tiles; 9=other, specify:

2. Please indicate the number and value of implements and other large household items that are owned by the household.

	1. No. of units owned	**2. Total value (current sales value of all units, not purchasing price)** *(UgShs. If asset not owned, put '0')*
1. Car/truck		
2. Tractor		
3. Motorcycle		
4. Bicycle		
5. Handphone/phone		
6. TV		
7. Radio		
8. Cassette/CD/ VHS/VCD/DVD/ player		
9. Stove for cooking (gas or electric only)		
10. Refrigerator/freezer		
12. Chainsaw		
13. Plough		
14. Cart or wheelbarrow		
16. Others (worth more than approx. 100,000 UgShs.)		

3. Please indicate the savings and debt the household has.

1. How much does the household have in savings in banks, credit associations or savings clubs?	*UgShs*
2. How much does the household have in outstanding debt?	*UgShs*

E. Forest resource base

1. How far is it from the house/homestead to the edge of the nearest natural or managed forest that you have access to and can use?	A. … measured in terms of distance (straight line)?	*km*
	B. … measured in terms of time (in minutes of walking)?	*min*
2. Does your household collect firewood? *If 'no', go to 7.*		*(Yes/No)*
3. **If 'yes'**: how many hours per week do the members of your household spend on collecting firewood for family use?		*(hours)*
4. Does your household now spend more or less time on getting firewood than you did 5 years ago? *(more, about the same, less)*		
5. How has availability of firewood changed over the past 5 years? *declined, about the same, increased* *If "about the same" or "increased," go to 7*		

6. **If declined** (code '1' on the question above), how has the household responded to the decline in the availability of firewood? *Please rank the most important responses, max 3.*	**Response**	**Rank 1-3**
	1. Increased collection time (e.g., from further away from house)	
	2. Planting of trees on private land	
	3. Increased use of agricultural residues as fuel	
	4. Buying (more) fuelwood and/or charcoal	
	5. Buying (more) commercial fuels (kerosene, gas or electricity)	
	6. Reduced the need for use of fuels, such as using improved stove	
	9. Other, specify:	

7. Has your household planted any woodlots or trees on farm over the past 5 years? *If 'no', go to next section.*		*(Yes/No)*
8. **If yes:** what are the main purpose(s) of the trees planted? *Please rank the most important purposes, max 3.*	**Purpose**	**Rank 1-3**
	1. Firewood for domestic use	
	2. Firewood for sale	
	3. Fodder for own use	
	4. Fodder for sale	
	5. Timber/poles for own use	
	6. Timber/poles for sale	

	7. Other domestic uses	
	8. Other products for sale	
	9. Carbon sequestration	
	10. Other environmental services	
	19. Other, specify:	

F. HIV/AIDS knowledge questions

*(Remember: The questions on this page are to be asked of **the patient**.)*

Yes/No questions

1.	Is AIDS spread by kissing?	Yes	No
2.	Can a person get AIDS by sharing kitchens and bathrooms with someone with AIDS?	Yes	No
3.	Can infected men give AIDS to women?	Yes	No
4.	Can infected women give AIDS to men?	Yes	No
5.	Must a person have many different partners to get AIDS?	Yes	No
6.	Can you get AIDS by touching someone with AIDS?	Yes	No
7.	Does washing after sex help protect against AIDS?	Yes	No
8.	Is AIDS caused by spirits/supernatural forces?	Yes	No
9.	Can a pregnant woman give AIDS to her baby?	Yes	No
10.	Can a person get rid of AIDS by having sex with a virgin?	Yes	No
11.	Is HIV the virus that causes AIDS?	Yes	No
12.	Is there a cure for AIDS?	Yes	No

G. Health Care questions

1. The following are three types of health services. **Please rank** these services from most to least preferred (most preferred = 1, least preferred = 3).

_____ Traditional medicine

_____ Formal private health services

_____ Formal public health services

2. **Please rank** these services from most to least used (most used = 1, least used = 3).

_____ Traditional medicine

_____ Formal private health services

_____ Formal public health services

Please check that all questions in the baseline survey have been answered before you leave the household!

Please continue speaking with the household head as you continue on to the quarterly survey. If the household head is <u>not</u> the patient, make sure you return to sections F and G in the baseline survey (above) when you speak with the patient.

Enumerator Comments:

Quarterly household survey (Q1)

Control information

Task	Date(s)	By who?	Status OK? If not, give comments
Interview			
Checking questionnaire			
Coding questionnaire			
Entering data			
Checking & approving data entry			

A. Identification

Household number		
Village	*(name)	(village ##)
Name and PID of household head	*(name)	(PID)
Name and PID of adult male (for parts B and C)	*(name)	(PID)
Name and PID of adult female (for parts D and E)	*(name)	(PID)
Name and PID of child (for parts F and G)	*(name)	(PID)
Name and PID of patient	*(name)	(PID)

Personal identification numbers (PIDs) should be the same as used in the baseline survey.

*** Note that the patient MUST be one of the respondents in lines 4 through 6 above, i.e., you MUST ask the patient the expenditure and time use questions.

This means that in some cases you may not be asking expenditures and time use for the household head (for example, when an adult male other than the male household head is the patient).

The child respondent should be any child between the ages of 10 and 15 that is readily available. When possible, the same child should be interviewed in subsequent quarterly surveys.

I Questions for individual household members

B. Adult Male – Cash Expenditures

****** RECORD PID NUMBER OF ADULT MALE RESPONDENT _____***

We are trying to understand how you spend your cash on a weekly basis.

*The following questions are with regards to purchases over the **last week**.*

That is between _____ and _____ .

What expenditures (cash spent on goods and services) have you made over the last week?

Expenditures	**Code**	**Date**	Amount spent

C. Adult Male – Time Use

*We are trying to understand how you spend your time from the time you wake to the time you go to bed. Could you describe what you did **yesterday**?*

Activity	**Code**	**Time begun**	**Time end**	**Total Time**

Total Time				

D. Adult Female – Cash Expenditures

****** RECORD PID NUMBER OF ADULT FEMALE RESPONDENT _____***

We are trying to understand how you spend your cash on a weekly basis.

*The following questions are with regards to purchases over the **last week**.*

That is between _____ and _____ .

What expenditures (cash spent on goods and services) have you made over the last week?

Expenditures	**Code**	**Date**	Amount spent

E. Adult Female – Time Use

*We are trying to understand how you spend your time from the time you wake to the time you go to bed. Could you describe what you did **yesterday**?*

Activity	**Code**	**Time begun**	**Time end**	**Total Time**

Total Time				

F. Child – Cash Expenditures

****** RECORD PID NUMBER OF CHILD RESPONDENT _____***

We are trying to understand how you spend your cash on a weekly basis.

*The following questions are with regards to purchases over the **last week**.*

That is between _____ and _____ .

What expenditures (cash spent on goods and services) have you made over the last week?

Expenditures	**Code**	**Date**	Amount spent

G. Child – Time Use

*We are trying to understand how you spend your time from the time you wake to the time you go to bed. Could you describe what you did **yesterday**?*

Activity	**Code**	**Time begun**	**Time end**	**Total Time**

Total Time				

H. Patient Questions about visit with Patient Partner

In the past week, did you travel away from your home to meet your patient partner?

___ YES ___ NO

If YES, answer questions 2 through 5 and then continue. If NO, continue to next page.

How often in the last week did you meet your patient partner away from your home?
____ (number of meetings)

Time spent traveling to visit patient partner: _____ (minutes one way per trip)

Distance from patient to patient partner __ KM

Most frequent mode of travel to visit patient partner:

___ Walk

___ Bicycle

___ Bus

___ Motorcycle (boda)

___ Taxi

___ Car

___ Other (Please specify: _____)

II Questions about the Whole Household (to be asked of the household head)

I. Collection and/or use of unprocessed ("raw") forest products

1. What are the quantities and values of raw-material forest products the members of your household collected for both own use and sale over **the past month**?

1. **Forest product** *(code-product)*	**2. Collected by whom?[1)]**	**Collected where?**		**6.** **Unit**	**7. Quantity for own use (incl. gifts)**	**8.** **Quantity for sale or barter**	**9. Price per unit if sold**	**10. Type of market** *(inside village, outside village (0-10 kms), >10 km outside village)*	**12.** **Cost of transport and/or marketing** **(total)**	**13. Cost of Purchased inputs and hired labour (total)**
		3. Land type *(natural forest, managed forest, or plantation)*	**4. Ownership** *(state, community, or private)*							

1) Codes: 1=only/mainly by wife and adult female household members; 2=both adult males and adult females participate about equally; 3=only/mainly by the husband and adult male household members; 4=only/mainly by girls (<15 years); 5=only/mainly by boys (<15 years); 6=only/mainly by children (<15 years), and boys and girls participate about equally; 7=all members of household participate equally; 8=none of the above alternatives.

J. Production of processed forest products

1. What are the quantities and values of processed forest products that the members of your household produced during **the past month?**

1. **Product** *(code-product)*	**2.** **Who in the household did the work?[1)]**	**4.** **Unit of processed product**	**5.** **Quantity for own use (incl. gifts)**	**6.** **Quantity for sale or barter**	**7.** **Price per unit if sold**	**8.** **Type of market** *(inside village, outside village (0-10 kms), >10 km outside village)*	**10.** **Cost of purchased inputs and hired labour**	**11.** **Cost of trans-port and/or marketing**

1) Codes: 1=only/mainly by wife and adult female household members; 2=both adult males and adult females participate about equally; 3=only/mainly by the husband and adult male household members; 4=only/mainly by girls (<15 years); 5=only/mainly by boys (<15 years); 6=only/mainly by children (<15 years), and boys and girls participate about equally; 7=all members of household participate equally; 8=none of the above alternatives.

2. What are the quantities and values of *unprocessed* forest products used as inputs to produce the *processed* forest products in the table above?

Note: The products in column 1 should be exactly the same as those in column 1 in the table above.

1. Processed (final) products *(code-product)*	**2. Unprocessed forest product used as input** *(code-product)*	**4. Unit of input/raw material**	**5. Quantity purchased**	**6. Quantity collected by household**	**Collected where?**		**9. Who in the household collected the forest product?[1)]**	**10. Price per unit if purchased**
					7. Land type *(natural forest, managed forest, plantation)*	**8. Ownership** *(state, community, private)*		

1) Codes as in the table above.

Note: Columns 7,8,9 should be left blank if no collection by household. Column 10 (price) should be asked even if only from collection, but if not available, see the Technical Guidelines on valuation.

K. Fishing and aquaculture

1. How much fish did your household catch **exclusively from the wild** (rivers, lake, sea) during **the past month**?

Type of fish (list local names)	**Collected where?**		**4. Quantity for own use (incl. gifts) in kg.**	**5. Quantity sold (including barter) in kg.**	**6. Price per kg if sold**	**8. Total costs (e.g., purchased inputs, hired labour, marketing)**
	2. Land type *(see note below)*	**3. Ownership** *(state, community, or private)*				

Note: Land types in column 2 may include natural forest, managed forest, plantation, cropland, pasture, agroforestry, silvipasture, fallow, or other

2. How much fish did your household catch **from ponds (aquaculture)** in **the past month**?

Type of fish (list local names)	**1. From where? (see note below)**	**3. Quantity for own use (incl. gifts) in kg.**	**4. Quantity sold (including barter) in kg.**	**5. Price per kg if sold**	**7. Total costs (e.g., purchased inputs, hired labour, marketing)**

Note: Possible answers include: 1=Pond owned by households; 2=Pond owned by group of which household is a member; 3=Pond owned by community/village; 4=Pond owned by others and persons can buy fishing rights (include costs in column 7); 9=Other, specify:

L. Wild Products (not from forests or fishing)

1. How much of **other wild products** (e.g., from grasslands, fallows, etc.) did your household collect **in the past month**?

1. Type of product *(code product)*	**Collected where?**		**5. Unit**	**6. Quantity for own use (incl. gifts)**	**7. Quantity for sale or barter**	**8. Price per unit if sold**	**10. Total costs (e.g., purchased inputs, hired labour, marketing)**
	2. Land type *(see note below)*	**3. Ownership** *(state, community, private)*					

Note: Land types in column 2 may include cropland, pasture, agroforestry, silvipasture, fallow, or other.

M. Wage income

1. Has any member of the household had paid work (i.e., paid in cash) over **the past month**?

Note: One person can be listed more than once for different jobs.

1. Household member (PID)	**2. Type of work** *(code-work)*	**3. Days worked past month**	**4. Daily wage rate**

N. Income from own business (not forest or agriculture)

1. Are you involved in any types of business, and if so, what are the gross income and costs related to that business over **the past month?**

Note: If the household is involved in several different types of business, you should fill in one column for each business.

	1. Business 1	2. Business 2	3. Business 3
What is your type of business? *(see note below)*			
Gross income (sales)			
Costs:			
Purchased inputs			
Own non-labour inputs (equivalent market value)			
Hired labour			
Transport and marketing cost			
Capital costs (repair, maintenance, etc.)			
Other costs			
10. Current value of capital stock			

Note: Responses may include 1=shop/trade; 2=agric. processing; 3=handicraft; 4=carpentry; 5=other forest based; 6=other skilled labour; 7=transport (car, boat,…); 8=lodging/restaurant; 19=other, specify:

****** Note that the following questions all refer to the PAST 3 MONTHS** (not the past month).*

O. Income from agriculture – crops

1. What are the quantities and values of crops that the household has harvested during **the past 3 months**?

1.Crops *(code-product)*	**2. Area of production** *circle one: ha / acre*	**4. Unit**	**5.Quantity harvested for own use (incl. gifts)**	**6. Quantity harvested for sale (incl. barter)**	**7. Price per unit if sold**

2. What are the quantities and values of **purchased** inputs used in crop production over **the past 3 months**?
Note: Take into account all the crops in the previous table.

Inputs	**1. Quantity of input**	**2. Unit**	**3. Price per unit**
Seeds			
Fertilizers			
Pesticides/herbicides			
Manure			
Draught power			
Hired labour			
Hired machinery			
Transport/marketing			
Other, specify:			
20. Total Payment for crop land rental:			*UgShs.*

P. Income from livestock

1. What is the number of ADULT animals your household has now, and how many have you sold, bought, slaughtered, or lost during the **past 3 months?**

	1. How many do you have now?	**2.How many sold (incl. barter) in past three months, live or slaughtered**	**3.How many slaughtered for own use (incl. gifts) in past three months?**	**4. How many have you lost in the past three months (theft, died,..)**	**5. How many have you bought or received in the past three months?**	**6. How many new adults from own stock in the last three months?**	**7. Average price per adult animal if bought or sold**
Cattle							
Goats							
Sheep							
Pigs							
Donkeys							
Ducks							
Chicken							
19. Other, specify:							

Appendix B2: Distribution of prices of products involved in activities

Price per unit of crop if sold (past three months)

Table B2.1: Summary statistics by crop product type and by pricing unit

Product name	Pricing unit code	Obser-vations	Mean	Std. Dev.	Min	Max
Rice	2	9	722.22	218.1042	400	1100
	8	3	91666.67	10408.33	80000	100000
	28	1	1100	.	1100	1100
	29	1	3500	.	3500	3500
Maize	2	167	197.485	65.35094	100	700
	8	88	15216.59	8608.019	180	30000
	29	2	3500	707.1068	3000	4000
Millet	2	11	440.9091	157.8261	200	750
	8	4	31250	23142.67	12000	60000
	29	1	1000	.	1000	1000
Sorghum	2	9	297.7778	167.8376	100	600
	8	4	26250	2500	25000	30000
	28	1	750	.	750	750
Groundnut	2	34	1179.412	320.5388	350	1800
	8	4	38000	10614.46	25000	50000
	29	6	3666.667	1538.397	1500	5000
	30	1	1700	.	1700	1700

Table B2.1: Summary statistics by crop product type and by pricing unit

(Continued)

Beans I	2	13	480.7692	230.5234	50	800
	8	2	35000	7071.068	30000	40000
	14	1	400	.	400	400
	28	1	700	.	700	700
	29	2	5850	212.132	5700	6000
Beans II	2	113	548.4956	310.6796	230	1800
	8	20	29545	16964.78	400	65000
	2	113	548.4956	310.6796	230	1800
Onion	11	1	1000	.	1000	1000
	29	3	4500	500	4000	5000
Tomato	29	10	12100	5546.771	4000	21000
	30	2	2000	0	2000	2000
	29	2	600	141.4214	500	700
Matooke	13	1	20000	.	20000	20000
	31	54	2487.963	935.3102	350	4000

Average price per adult animal if bought or sold (past three months)

Table B2.2: Summary statistics of price of current animals in the household

Animal	Obs	Mean	Std. Dev.	Min	Max
Cattle	24	213958.3	91828.99	100000	400000
Goats	100	30580	6861.075	20000	45000
Sheep	7	37857.14	20177.78	15000	75000
Pigs	31	51064.52	18906.68	20000	80000
Ducks	34	3691.176	834.9805	2500	6000
Chicks	137	3537.226	740.7277	2500	5000

Values of purchased inputs used in livestock production

Table B2.3: Values of purchased inputs used in livestock production (in USh) -summary statistics

Animal	Obs	Mean	Std. Dev.	Min	Max
Feed/fodder	25	17330	25166.81	250	100000
Rental of grazing	3	21666.67	14433.76	5000	30000
Medicines, vaccination	60	11294.17	15835.82	150	90000
Barn maintenance costs	10	19360	24173.59	600	65000
Hired labour	14	25607.14	22981.75	2000	75000

Appendix B3: Transformation of the gross income variable

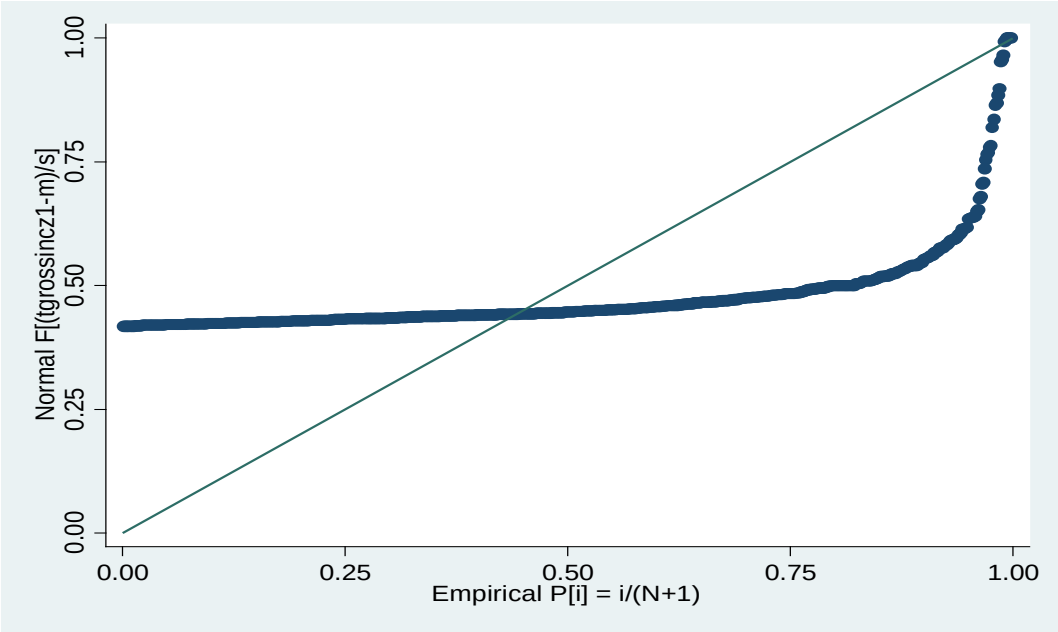


Figure B3.1: Normal probability plot of the variable gross income

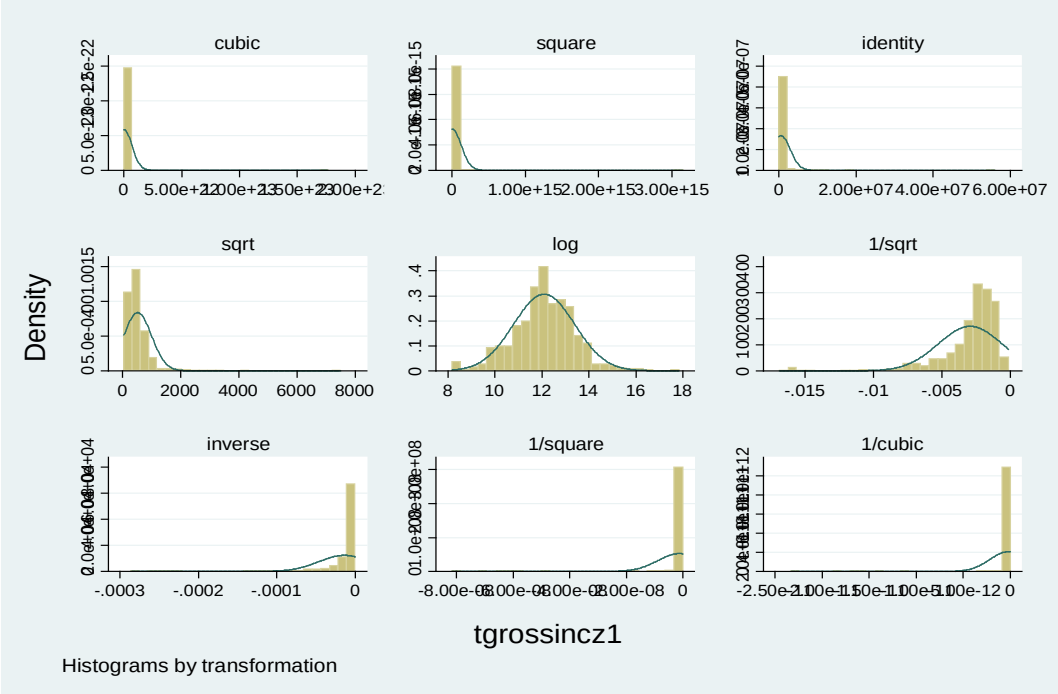


Figure B3.2: Performance of different transformations of the dependent variable gross income

Appendix B4: Output of the Principal Component Analysis Model

```
. factor lvpbase val_items hhitems homesize landsize , pcf
(obs=665)

Factor analysis/correlation                       Number of obs    =        665
    Method: principal-component factors           Retained factors =          2
    Rotation: (unrotated)                         Number of params =          9
```

Factor	Eigenvalue	Difference	Proportion	Cumulative
Factor1	1.84988	0.80340	0.3700	0.3700
Factor2	1.04647	0.04718	0.2093	0.5793
Factor3	0.99929	0.24478	0.1999	0.7791
Factor4	0.75451	0.40467	0.1509	0.9300
Factor5	0.34985	.	0.0700	1.0000

```
    LR test: independent vs. saturated:  chi2(10) =  445.27 Prob>chi2 = 0.0000

Factor loadings (pattern matrix) and unique variances
```

Variable	Factor1	Factor2	Uniqueness
lvpbase	-0.0786	0.3119	0.8966
val_items	0.7962	-0.4285	0.1825
hhitems	0.8584	-0.2389	0.2061
homesize	0.4384	0.6371	0.4019
landsize	0.5298	0.5501	0.4167

```
. screeplot, yline(1)

. rotate

Factor analysis/correlation                       Number of obs    =        665
    Method: principal-component factors           Retained factors =          2
    Rotation: orthogonal varimax (Kaiser off)     Number of params =          9
```

Factor	Variance	Difference	Proportion	Cumulative
Factor1	1.66087	0.42538	0.3322	0.3322
Factor2	1.23548	.	0.2471	0.5793

```
    LR test: independent vs. saturated:  chi2(10) =  445.27 Prob>chi2 = 0.0000

Rotated factor loadings (pattern matrix) and unique variances
```

Variable	Factor1	Factor2	Uniqueness
lvpbase	-0.2200	0.2346	0.8966
val_items	0.9041	0.0114	0.1825
hhitems	0.8666	0.2074	0.2061
homesize	0.0744	0.7698	0.4019
landsize	0.1965	0.7381	0.4167

```
Factor rotation matrix
```

	Factor1	Factor2
Factor1	0.8745	0.4850
Factor2	-0.4850	0.8745

```
. loadingplot, factors(2) yline(0) xline(0)

. predict f1 f2
(regression scoring assumed)

Scoring coefficients (method = regression; based on varimax rotated factors)
```

Variable	Factor1	Factor2
lvpbase	-0.18169	0.24001
val_items	0.57500	-0.14934
hhitems	0.51653	0.02540
homesize	-0.08801	0.64734
landsize	-0.00451	0.59863