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The HIV Anticipatory Saving Motive: an Empirical Analysis in South Africa

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ABSTRACT *This paper studies the effect of the HIV/AIDS epidemic on saving behaviour. Two important characteristics of HIV result in opposing forces on savings: mortality increases, which reduces savings, and long-term illness risk increases, which enhances savings. We use a two period life-cycle model with uncertain lifetime including perceived HIV contamination risk to illustrate both the opposing effects of the HIV epidemic on individual savings and test the predictions of our model with data obtained from an economic experiment with real monetary incentives performed in South Africa. The empirical results show that increased mortality decreases the amount of savings and that having a high perception of HIV contamination risk increases savings. The latter effect confirms the HIV anticipatory saving hypothesis.*

KEYWORDS: HIV/AIDS, saving behavior, illness risk, mortality, life-cycle model, time preferences.
JEL CODES: D12, D91, E21, I12.

I. Introduction

After its discovery in the late 1970s, the HIV/AIDS epidemic has rapidly developed into a widespread catastrophe in Sub-Saharan Africa. Over 25 million people have died of AIDS related diseases and 38.6 million people are living with HIV worldwide. High levels of adult prevalence rates are concentrated in Southern Africa with 18.8 per cent in South Africa (UNAIDS, 2006). The erosion of some of the main determinants of economic growth such as social capital, domestic savings, and human capital caused by HIV/AIDS damages both social and economic development. Many studies have been written on the effects of the HIV/AIDS epidemic on economic growth. However, little attention has thus far been given to the possible indirect economic behavioural effects of HIV epidemic. The effect of HIV/AIDS on individual saving behaviour is the central topic of this paper.

Once HIV infected, uninsured individuals face a long period of high expenses. The treatment of the disease requires additional expenses on healthy food and medical treatment. Steinberg et al. (2002), for example, show that in South Africa, AIDS affected households spend more than a third of households' income on private medical care. At the same time, however, the disease lowered income with one third as a result of a decrease in productivity or loss of job.

While in developed countries families with sick members are able to access formal insurance markets, families in low-income countries must rely on informal mechanisms like participating in informal insurance groups (LeMay, 2006), or individual savings. LeMay (2006) shows that while 51 per cent of the households in Cotonou (Benin) made expenses related to funerals and/or illness during the last six months, only 18 per cent of the surveyed observations were participating in some form of insurance, to cover these costs. Dercon and Krishnan (2000) show that although risk-sharing does occur within poor households in Ethiopia, full insurance against illness shocks does not. This might be due to the inability to predict actual illness risk and the associated costs. Pettifor et al. (2004) for instance, show that the youth in South Africa is indeed unable to correctly predict their HIV infection risk: only 21 per cent of the HIV positive youths qualified their risk as high, whereas 62 per cent reported to have a small HIV infection risk or no infection risk at all. Another explanation for underinsurance can be that households cannot afford full insurance and therefore save instead.

Several impact studies like Booysen & Visser (2006) and Marzo (2004) show that HIV affected households fall into chronic poverty. This fact could stimulate unaffected households to anticipate the costs of illness by increasing savings.

It could thus be hypothesized that there is a positive relationship between HIV contamination risk and individual savings: individuals with a high contamination risk increase savings if they take the possible additional future costs caused by the illness into account when deciding how much to save. We will call this hypothesis the *HIV anticipatory saving hypothesis*. On the other hand, being HIV infected significantly reduces life expectancy. Therefore, the probability of reaching the retirement age declines and agents will be less inclined to safe in order to have income when retired. Because the HIV epidemic causes both a decrease in life expectancy and an increase in the expectancy of near future illness, the overall effect of the HIV epidemic on individual saving behaviour is ambiguous.

Although to the best of our knowledge the HIV anticipatory saving hypothesis has not been tested empirically, results from existing studies on the economics of HIV/AIDS do indirectly support the presence of the aforementioned opposing effects of the HIV epidemic on saving behaviour. For example, Ferreira and Pessoa (2003), and Freire (2004) found a negative relationship between the HIV epidemic and saving behaviour due to a fall in life expectancy. In his study about the macroeconomic effects of the HIV/AIDS epidemic using cross-country regressions, Bonnel (2000) found that the increase in the HIV prevalence rate from 1990 to 1996 reduced the savings rate in developing countries with -0.61 percentage points. Bonnel (2000) does however mention that in a well-established HIV epidemic savings could increase because households increase their savings to cover the expected higher medical costs if they view the risk of contracting AIDS related diseases as significant. Kochar (2004) found that higher expectations about future illness increased overall savings in Pakistani households, as predicted by the HIV anticipatory saving hypothesis. Pradhan et al. (2006) empirically show that HIV affected households[1] in India have lower levels of savings and almost half of these households had either borrowed money or liquidated assets for consumption.

This paper presents a two-period lifetime optimization model that illustrates the opposing effects of HIV contamination risk on individual saving behaviour. This model is based on the

life-cycle theory (Ando & Modigliani, 1957), which posits that agents smooth consumption over their expected lifetime. We test the predictions of our simple model using data from a laboratory experiment with real monetary incentives held among students in South Africa. The results indicate that both effects of the HIV epidemic (increased mortality and increased illness risk) indeed affect individual saving behaviour as predicted by our model. The results thus plead for educating the population with correct and actual information on the magnitude of the disease and their actual lifetime HIV contamination risk. Providing this information will encourage savings and thus will reduce the welfare loss caused by the HIV epidemic.

The remainder of the paper is organized as follows. The next section presents a simple two-period lifetime optimization model to illustrate the opposing effects of the HIV epidemic on individual saving behaviour. Section 3 presents the experimental design followed by the experimental and estimation results in Section 4. Section 5 concludes.

II. Model

We consider a country where a large group of agents (normalized to one) optimizes consumption over two periods. When HIV starts to spread it affects individual savings in the following way. First, the period over which agents optimize consumption declines because there is a fall in life expectancy. The model operationalizes this effect through an increase in perceived mortality risk. We assume that HIV contaminated agents will not enter the second period. Second, in a well-established HIV epidemic, agents will become aware of the HIV contamination risk they face. Agents understand the necessity of expensive medical treatment whenever they become HIV positive. This enhances savings, as predicted by the HIV anticipatory saving hypothesis.

Agents face a mortality risk q (that is, with probability q agents do not enter the second period) and a certain risk p of contracting HIV. Agents optimize a simple logarithmic lifetime utility function and discount the future with discount factor $\delta = \frac{1}{1+\check{r}}$, where $\check{r}$ is the discount rate. Agents only earn income W in the first period and earn interest rate r on their savings s in the second period. Savings of the deceased are distributed equally among their generation. Because agents are aware of the mortality risk of their generation, they consider the transfers of the deceased in the expected future income when optimizing their lifetime utility. The

expected return on savings for agents that survive to the second period R is then defined as $R = \frac{1+r}{1-q}$. Agents can spend income on regular consumption (c_i) in both periods, but to keep things simple we assume that only HIV contaminated agents are allowed to spend income on medical treatment, m_2 with price P_m. The parameter $\mu > 0$ is the marginal rate of substitution of regular and medical consumption (see Problem (1) below).[2]

$$\begin{aligned} \max_{c_1} U(c_1, c_{2G}, c_{2I}, m_2) &= \ln c_1 + (1-q)\delta[(1-p)\ln c_{2G} + p\ln c_{2I} + p\mu \ln m_2 \\ s.t.\ c_1 &= W - s \\ c_{2G} &= \mathrm{R}(w - c_1) \\ c_{2I} &= \mathrm{R}(w - c_1) - P_m m_2 \end{aligned} \tag{1}$$
$$\text{where } c_1, c_{2G}, c_{2I} \geq 0, m_2 > 0.$$

Taking the first order condition with respect to m_2, and backward substituting m_2^* into the maximization problem gives the optimal spending on regular and medical consumption.[3]

$$\begin{aligned} m_2^* &= \frac{\mathrm{R}(W - c_1)\mu}{(1+\mu)P_m} \\ c_2^* &= \frac{W}{(1-q)\delta(1+p\mu)+1} \end{aligned} \tag{2}$$

Taking first derivatives with respect to q and p illustrates the opposite effects that the HIV epidemic has on individual savings. A marginal increase in mortality risk (q) negatively affects the amount of money agents save. However, a marginal increase in perceived HIV contraction risk (p) induces people to save more (consume less) in the first period. Note that for $0 < \mu \leq 1$ the marginal effect of an increase in p on savings in this model is smaller than the effect of a marginal increase in q. The more important medical consumption becomes compared to regular consumption the larger the relative effect of the HIV anticipatory saving motive compared to the mortality effect.

$$\frac{\partial s}{\partial p} = \frac{W(1-q)\delta\mu}{[(1-q)\delta(1+p\mu)+1]^2} > 0 \tag{3}$$

$$\frac{\partial s}{\partial q} = \frac{-W(1-p\mu)\delta}{[(1-q)\delta(1+p\mu)+1]^2} < 0 \qquad (4)$$

A limitation of this simple two-period model is that medical consumption does not prolong lifetime of HIV positive agents. Incorporating this effect would enhance the HIV anticipatory saving motive even further.

III. Experimental Design

To test the predictions of our simple model, we used data from an economic experiment with real monetary incentives held among students in South Africa. This experiment builds on the discount rate experiments of Coller and Williams (1999) and Harrison et al. (2002). This section presents a short description of the experimental design. For a more detailed description of the experiment including the experimental instructions, see Lammers et al. (2006).

Participants

A total of N = 213 students (114 males and 99 females) from a wide range of disciplines recruited at the Northwest University and the University of Pretoria in South Africa participated in the experiment. Students took part in 12 groups of around 20 respondents each. 82.0 per cent of the respondents was black South African, 15 per cent of the respondents was white, and the remaining 3 per cent was coloured. The average age of the white participants (15%) was 21.1 years (ranging from 19 till 24 years) whereas the average age of non-white (coloured and black South African) participants was 22.9 years (ranging from 18 till 36 years). On average non-white students were poorer; the income distribution of non-white subjects is skewed to the left whereas the income distribution of white students is skewed to the right.

Procedure

At the start of the experiment, subjects received experimental instructions and the random devices used throughout the experiment (a bingo cage containing 100 balls, a 6-sided die, and a 10-sided die) were presented to subjects. In the instructions it was emphasized that the

experiment was anonymous (since it also involved sensitive questions related to health states) and that there were no right or wrong answers. Both at the start and at the end of the experiment, participants were asked to fill out a short questionnaire. The first questionnaire concerned questions regarding socio-demographic characteristics such as age, gender, race etc., while the questionnaire at the end of the experiment concerned questions on financial instruments such as whether the participant did save or not and the current balance on participants' savings account and health related questions including questions on perceived HIV contamination risk, HIV status and perceived life expectancy.

Stimuli

Because individual time preferences play a central role in saving behaviour, we measured individual discount rates in the experiment. More specifically, we adjusted the so-called *multiple price list design* (MPL) used by Harrison et al. (2002) to our setting. Participants were asked to make 20 outright choices between two options, called option A and option B, by simply encircling the preferred option on a sheet of paper. Both options yielded monetary prizes at specified dates. More specifically, option A yielded 172 Rand in X months, while option B yielded an amount of Y Rand in Z months. The amount Y that option B yielded increased after each choice, starting at Y = 172.43 Rand. Thus, option B became more and more attractive after each choice. In addition, participants received information about the annual interest rate that reflected the different prizes offered by option B, similar to Coller and Williams (1999) and Harrison et al. (2002). The options were presented in a table format similar to Table 1 reproduced below, as to make the task as easy and transparent as possible.

Motivating Participants

In addition to a show-up fee of 30 Rand, we used performance-based real incentives to motivate participants based on the random lottery incentive system, the nowadays almost exclusively used incentive system for individual choice experiments (Holt and Laury, 2002). The main advantage of this system is that it avoids income effects such as Thaler and Johnson's (1990) house money effect, while it has been shown empirically that it is indeed incentive compatible, that is, agents do not interpret choice tasks rewarded with the random

lottery incentive system as one grand overall lottery (Cubitt et al. 1998, Starmer and Sugden 1991). Since the task reported here was part of a larger experiment that all involved outright choices between two options, the probability that one of the chosen options would be played out for real was low. When selected for additional payment, subjects received a post-dated check issued by Tilburg University, which could be cashed at any Standard Bank in South Africa any time after the specified date.

Table 1. Framing of the options (FED-treatment)

Decision	Option A To be paid in 1 month	Option B To be paid in 24 months	Annual Interest rate	Your choice (Circle A or B)
1	R 172	R 182.60	3%	(A) B
2	R 172	R 193.76	6%	(A) B
3	R 172	R 205.51	9%	(A) B
4	R 172	R 217.88	12%	(A) B
5	R 172	R 230.90	15%	(A) B
6	R 172	R 244.60	18%	(A) B
7	R 172	R 259.00	21%	(A) B
8	R 172	R 274.14	24%	(A) B
9	R 172	R 290.05	27%	A (B)
10	R 172	R 306.76	30%	A (B)
11	R 172	R 324.30	33%	A (B)
12	R 172	R 342.72	36%	A (B)
13	R 172	R 362.05	39%	A (B)
14	R 172	R 382.32	42%	A (B)
15	R 172	R 403.58	45%	A (B)
16	R 172	R 425.87	48%	A (B)
17	R 172	R 449.22	51%	A (B)
18	R 172	R 473.69	54%	A (B)
19	R 172	R 499.32	57%	A (B)
20	R 172	R 526.15	60%	A (B)

Treatments

There is empirical evidence that agents are more impatient about immediate delays than they are about future delays of the same length (Coller and Williams, 1999). Therefore, the timing of the prizes of both options varied between treatments. More specifically, in one treatment, called NFED (no front end delay), option A always yielded an immediate prize while option B yielded a prize that would be paid in 23 months. In the other treatment, called FED (front end delay), option A always yielded a prize that would be paid in one month while option B yielded a prize that would be paid in 24 months.

IV. Results

Descriptive Statistics

First of all, the results show that most students owned a savings account: 64.4 per cent of our subjects reported to save and of these 52.6 per cent reported to use informal saving methods. 82 per cent reported to save using a formal account. Table 2 below shows how saving behaviour differs among groups of subjects having different levels of perceived HIV contamination risk classified by no risk at all, small, moderate, high or HIV positive.

Table 2. Descriptive Statistics

Perceived HIV contamination risk	N (%)	Has medical insurance	Saves	Saver having savings account	Saver uses informal saving methods	Average amount of savings on scale 1-4	Average discount rate[4] in %
Not at all	54 (27.4%)	30.8%	65.4%	78.8%	55.9%	1.54	38.36
Small	83 (42.1%)	39.3%	61.4%	80.0%	51.9%	1.53	41.30
Moderate	28 (14.2%)	17.9%	60.7%	94.1%	70.6%	1.99	38.09
High	25 (12.7%)	28.0%	64.0%	73.3%	37.5%	2.19	44.61
HIV positive	23 (10.8%)	30.4%	78.3%	88.9%	44.4%	3.09	25.72
Total	213 (100%)	32.1%	64.4%	82.0%	52.6%	1.72	38.80

Subjects with a high perception of HIV contamination risk and HIV positive subjects appear to save more often compared to subjects that indicated to perceive their contamination risk as small or moderate. The amount of savings of HIV positive subjects and subjects with a high perception of HIV contamination risk is also significantly higher compared to the other groups (t=-2.165, p-value=0.030). Note however, that the group of subjects that indicated to perceive their contraction risk as high did report to use both informal and formal saving methods less frequently. The amount of savings among those who have a savings account however, is higher for this group and for the group of HIV positive respondents.

Life Expectancy

Due to the HIV pandemic, life expectancy in South Africa has fallen from an average of 63.2 years to 42.7 years over the period 1990-2006 (U.S. Census Bureau 2006). The reported life expectancy of our subjects varies from 25 to 120 years, with a mean of 72.4 years, which is substantially higher than the country average for people at age 20-24, which varies from 55 to 60 years (WHO 2007). Subjects who indicated to be HIV positive reported a significantly lower life expectancy (59.1 years). Subjects who have a higher perceived HIV contraction risk reported an average life expectancy of 68.9 years, which is 4.6 years lower compared to subjects who indicated to have a lower risk.

Perceived HIV Contamination Risk

The largest part of the subjects (80.9%) reported that HIV is the major cause of death in the North West province. Tuberculosis, a disease that is an important cause of death for many HIV infected patients, was seen as the second most important cause of death (60.3%). This shows some understanding of the HIV epidemic among the subjects. Subjects estimated their own risk of getting HIV infected significantly lower than the risk of other students.

Although 57.2 per cent of the non-white participants indicated that the HIV contamination risk of other students was high, only 15.9 per cent of them perceived their own HIV contamination risk as high. None of the subjects reported that other subjects' HIV contamination risk was zero, whereas 27.5 per cent indicated that their own HIV contamination risk was zero. 25.0 per cent of the white participants reported to perceive others' HIV contamination risk as high, which is rather low compared to the 57.1 per cent of

the non-white participants. In general, these numbers again show a substantial awareness of HIV among subjects participating in the experiment.

The overall reported HIV prevalence rate among the sample was 10.9 per cent. However, 4.7 per cent of the subjects indicated to prefer not to report their test- or HIV status. This prevalence rate is comparable with the average prevalence rate (9.9%) among the youth in the North West province (Pettifor et al., 2004), but the observed prevalence rate is high if we consider the fact that among the students that are HIV positive only 10 per cent is also aware of their status (Pettifor et al., 2004). Finally, 12.7 per cent of subjects indicated to have a high HIV contamination risk (see Table 2).

Discount Rates

For each individual we estimated the individual discount rate by taking the average discount rate when a subject switched from choosing option A to option B. Thus, for example, from the choices made by the hypothetical subject whose choices are listed in the fifth column of Table 2, we would infer that the individual discount rate was equal to 25.5 per cent.

The resulting average discount rate over all sessions was 34.78 per cent, which is substantially higher than an average discount rate of 24.2 per cent obtained by Harrison et al. (2002). This implies that the average South African is more impatient than the average Dane, which is perhaps not surprising if we consider the economic differences between both countries. Compared to previous studies conducted in Western countries, we find that a remarkable large proportion of subjects (42.6%) switched between the options more than once. If a participant switched more than once between options, then the discount rate was assumed to be equal to the midpoint of the interval over which the subject is indifferent.

As Table 2 shows, subjects with high-perceived HIV contamination risk had a higher discount rate in the experiment. On the other hand, subjects who knew that they are HIV positive strikingly showed to be very patient. HIV infection thus seems to affect discount rates which may be explained by the HIV anticipatory saving hypothesis: HIV positive subjects might be aware of the additional spending they will face at the time they become ill, and are therefore prepared to delay consumption for a relatively long time. The last column of Table 2 displays the average discount rates for each group of subjects. The observed discount rates are

in agreement with 'common sense' observations. Among the subjects who considered themselves to have no HIV contamination risk at all, a relatively large percentage had the lowest discount rate, while, on the other hand, among the group of subjects that indicated to have a high contamination risk, a relatively large percentage had the highest discount rate. Our findings are supported by Chesson et al. (2006) who show that unsafe sexual behaviour is positively related to time preferences.

The major drawback of the experimental method as often applied in Western countries is the debatable assumption that subjects are credit constrained. The financial data of our sample, however, shows that this assumption among students in South Africa is less contentious. Subjects appear to have little arbitrage possibilities. Only 9.9 per cent of the subjects reported to have a line of credit. Furthermore, only 15.9 per cent reported to have a chance of at least 90 per cent of being approved to obtain a loan if they would go to a bank.

Estimation Results

In order to test the hypothesis that there is a significant positive relationship between saving behaviour and perceived HIV contamination risk and life expectancy as predicted by the life savings model presented in Section 2 while controlling for individual differences between discount rates, marital status, gender, race, and the probability of obtaining a loan, we performed a Simple Ordered Probit regression analysis using the amount of savings on a 4-point scale as the dependent variable. To capture the variation in socio-economic background of our subjects, we included a dummy for subjects who lived in an informal dwelling in the regression. The results of this simple regression are reported in Table 3 below.

First of all, as can be seen in the table, students that reported to have a small probability of obtaining a loan significantly save less. This finding can be explained by the lack of income to be able to save and the related lack of collateral to obtain a loan. White students appear to significantly save more, possibly because they face less liquidity constraints.

Interestingly, there is a significant positive relationship between perceived HIV contamination risk and the amount of savings. This finding supports the HIV anticipatory saving hypothesis: If individuals consider the risk of contracting the virus and are aware of the related costs of being HIV infected, they save in order to anticipate these costs. The HIV

positive subjects in our sample significantly save more as well. It should be noted here, that all our HIV positive subjects did not have AIDS yet. Although their spending pattern might already have changed (in order to delay the development of HIV into AIDS, infected individuals need things like balanced food, and medical care etc.), the most expensive period in which they are going to need extensive medical care and treatment is still to come. The savings effect for HIV positive students appear to be higher than those of students who perceive to be highly at risk, which can be explained by the fact that HIV positive students know for sure that the expensive period is looming ahead, while for the other group this is still just a risk.

Table 3. Estimation Results

	Estimate	Standard Error
Discount Rate	0.003	0.004
Female	-0.065	0.267
White	1.210	0.388***
Urban	-0.365	0.293
Informal Dwelling	0.664	0.423
High Perceived HIV Contamination Risk[5]	1.140	0.466**
HIV Positive	1.463	0.443***
Perceived Life Expectancy (years)	0.019	0.009**
Medical Insurance	-0.752	0.341**
Poor Chances Loan	-0.541	0.273**

Dependent variable: amount of savings on a 4-point scale

In addition, Table 3 shows that students who have medical insurance, and therefore do not expect a dramatic increase in expenditures in case they become infected, save significantly less. Savings thus appears to be a substitute for medical insurance. This is not surprising in a

country where many people do not have access to or cannot afford to have full medical insurance and as a result use savings as 'insurance' for illness risk. The coefficient for a positive HIV status appears to be higher than that for the dummy for medical insurance. This indicates that medical insurance alone does not insure individuals for the full costs of illness. The fall in income and the need for a different consumption pattern seems to enhance savings as well.

Perceived life expectancy significantly increases the amount of savings as well, which is in line with what life cycle theory predicts. Thus, our empirical results clearly show that both opposing effects of HIV on individual saving behaviour are present in our data. The overall effect of a fall in life expectancy with, for example, 15 years on savings is less than the effect of having a high perception of HIV contamination risk are being HIV positive. This implies that individual savings among participants in the experiment are positively affected by the HIV epidemic overall.

Although students that had lived in informal dwellings appear to save more (p-value=0.116), the other variables, gender, urban, and individuals' discount rate have an insignificant effect on the amount of money students save.

V. Conclusion

This paper presents empirical evidence that suggests that the HIV epidemic has a positive effect on individual saving behaviour, as predicted by the HIV anticipatory saving hypothesis. To illustrate this effect we used a simple life cycle model that includes mortality risk and HIV contracting risk. The HIV anticipatory saving hypothesis posits that in a well-established HIV epidemic, agents consider the improved risk of contracting HIV and will save additionally to be able to make possible future expenses on medical treatment or a decrease in income due to illness. Results from a regression model with data from a laboratory experiment using real monetary incentives in which we controlled for differences between individual discount rates, gender, race, way of life, the probability of obtaining a loan, and having medical insurance, show that there is a nonlinear relationship between HIV prevalence rate and saving behaviour. The results show that HIV contamination risk and a positive HIV status positively affects savings. Furthermore, we find that although individual saving is a substitute for medical

insurance, the total increase in savings cannot be explained by the lack of medical insurance alone. Individuals seem to save on top of that for, for example, a lack of future income and additional illness-related expenditures not covered by medical insurance.

The HIV epidemic seriously affects economic growth by the erosion of social and human capital, domestic savings, and human capital. This study shows that it is also important that the population of countries hit by the HIV/AIDS epidemic knows its contamination risk from an economic point of view. Anticipatory saving improves the coping ability of HIV/AIDS infected households. Government inaction with respect to HIV knowledge will make the countries where the HIV epidemic is spreading worse off with respect to economic growth and welfare through the negative effects on the amount of savings caused by an increase in mortality risk. Our results therefore plead for HIV prevention campaigns that encourage HIV testing and educate the population with correct and actual information on the magnitude of the disease and their actual lifetime HIV contamination risk. These policies will induce an HIV anticipatory saving motive and thus positively affect social welfare and may therefore partly indemnify the disastrous effects that the HIV epidemic has on the hardest hit countries.

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Notes

1. A HIV affected household in the most limited definition is a household that consists of at least one infected member. In the broadest definition every household in the hardest hit countries are HIV affected since the far-reaching consequences of the disease in society. In this paper, by affected household, we mean the limited definition.

2. $\mu > 1$ shows the importance of medication since it improves the quality of life. $\mu < 1$ might incorporate the disutility of taking medicines.
3. In this paper medical consumption is a generic term for the additional consumption that is advised for HIV infected individuals. It includes for example medical care and treatment, healthy balanced food, supplements and immune boosters and so forth.
4. We use the discount rate, which is corrected for mortality, risk aversion, and the treatment effect as described in Lammers and Van Wijnbergen (2007).

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