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The Socio-Economic Distribution of AIDS Incidence and Output

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Abstract

This paper investigates the effect of HIV/AIDS on output in an overlapping generations economy calibrated to sub-Saharan Africa. I use skill heterogeneity as a proxy for socioeconomic status and test scenarios where the AIDS epidemic affects skills differently. The results indicate that the effects of the epidemic are sensitive to the distribution of the disease across skills. In general, the effect is much greater as the epidemic mainly affects skilled workers. Output is found to be below a no-AIDS output in a range between 3% (10%), when only unskilled workers are affected, and 10% (28%), when only skilled workers are affected, whenever the overall infection rate is 7% (20%). When investigating the hypothesis that AIDS affects skilled workers more severely than unskilled at the beginning of the epidemic, with the effect switching as the epidemic becomes more mature, the findings are that the economy can be 8% smaller along the transition path. In all scenarios where the epidemic is temporary, it would take 4 to 5 generations or about 90 years for sub-Saharan Africa to recover.

Key Words: HIV/AIDS, capital-skill complementarity, heterogeneity, and sub-Saharan Africa.

JEL Classification: E20

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1 Introduction

AIDS killed an estimated 2.1 million people in 2007 (UNAIDS (2007)). According to UNAIDS epidemic update for the year 2007, the number of people living with HIV in the world is between 30.6 and 36.1 million, and the number of newly infected was between 1.8 and 4.1 million. Within 10 years, the majority of these people will have contracted AIDS and died. This situation is exacerbated in sub-Saharan Africa, where two thirds of all HIV infected people live. This epidemic is unique because it mainly kills individuals in their prime productive years, hence, the consequences of such a disastrous event must be investigated. The question of how AIDS affects output is, therefore, extremely important.

Since the beginning of the HIV/AIDS epidemic in the eighties, several studies were conducted to investigate the possible links between the epidemic and economic growth and well being. Most of these studies were country specific and used either Solow type growth models or computable general equilibrium (CGE) models to simulate these effects. There was also another class of papers that used regression models with cross-sectional or panel data to investigate this relationship. With the exception of a few, almost all these studies point towards quite large long-run effects of AIDS on growth of GDP with little effect on GDP per capita. A summary of such studies can be seen in table 1.

Hamoudi and Birdsall (2002) study the relationship between human capital accumulation and AIDS. Since AIDS significantly reduces work productivity, it negatively affects human capital and, therefore, output. Another channel at which AIDS affects human capital negatively is through the increase in the orphan population since educational attainment of orphans is in general smaller compared to non-orphan children. That is, children that have infected parents tend to drop out of school to work in order to support their household, and upon their parent's death, most likely will not go back to school.

In order to capture this interaction between parents' health status and children's education, Corrigan, Glomm, and Mendez (2005) use an overlapping generations framework where reduced life expectancy generates reduced incentives to invest and therefore lowers both physical and human capital accumulation with great consequences for out-

put. This result is in large part due to lower education received by AIDS orphans. Their main findings, as shown in table 1, is that AIDS has large growth effects, but policies to subsidize the price of treatment medication have small remedial effects. This framework is more appropriate for analyzing the long-run implications of HIV/AIDS on growth and output.

The current paper will incorporate skill heterogeneity into the framework of Corrigan, Glomm, and Mendez (2005) by having an aggregate production function measuring GDP as a function of current capital stock and effective skilled and unskilled labor units. Capital-skill complementarity will be assumed and HIV risk will differ between skill levels. Hence, this paper will combine features from the literature on socioeconomic status and AIDS with the overlapping generations setting. The main goal here is to investigate how the relationship between AIDS prevalence and socioeconomic status affects output. I calculate transition paths after the economy is affected by AIDS and show how different these paths are with respect to different scenarios. This allows for long-run as well as short to medium run results.

The relationship between AIDS and socioeconomic status is an important issue, since it not only can shed some light into where preventive policies must be targeted, but also because depending on how serious the epidemic is among skilled workers, and given that these workers complement existing capital stock, the effects of such an event can be disastrous as in Kambou, Devarejan, and Over (1992). The literature on this relationship is extensive and contradictory. By looking at data, there is no clear consensus on how HIV/AIDS incidence is distributed across skills. Review papers such as Hargreaves and Glynn (2002) and Wojcicki (2005) have found ambiguous results on this relationship by searching for studies where socioeconomic status and HIV prevalence were investigated using population based surveys such as the demographic health surveys (DHS).

Out of a total of 36 studies, Wojcicki (2005) cites 15 studies where no association between socioeconomic status and AIDS was found. In 12 studies, there was a positive association between high socioeconomic status and AIDS, and in the remaining 8 the association was between low socioeconomic status and AIDS. Roughly the same conclusions are reported in Hargreaves and Glynn (2002). This apparent controversy has found explanation in Vandermoortele and Delamonica (2000), where they claim that in

the beginning of the epidemic, AIDS affects higher skilled individuals more relative to lower skilled; and as the epidemic runs its course and becomes more widespread, the disease becomes more prevalent among unskilled individuals relative to skilled. Hence, studies performed in the eighties would have different results compared to studies performed in the late nineties¹.

For example, using data from Rwanda, Zaire, and Zambia in the late eighties Over (1992) and Kambou, Devarejan, and Over (1992) document that higher skilled workers have a higher probability of infection relative to lower skilled workers. In Zambia for the year 1985 with blood donor and hospital staff data, using years of education as the measurement of socioeconomic status, they report HIV infection rate of 33.3% for highly educated individuals (15 years or more) and 8% for uneducated individuals (0 to 4 years). In Rwanda, for the year 1987 with urban wives data, they report infection rates by husband's education, monthly income of husband, and job of husband. In all cases, the more skilled the husband, the higher the infection rate on wives. In Zaire (1987), using textile factory urban employees data, they report infection rates of 5.3% for executives, 4.6% for foremen, and 2.8% for workers.

Arndt and Lewis (2000), using an ING-Barings study for the year 1999 in South Africa, report higher AIDS incidence among unskilled workers compared with skilled. Nattrass (2003), using South African 1996 census data, reports that the projected HIV prevalence for 2005 was 13.3% among highly skilled workers, 20.2% among skilled, and 22.8% among unskilled; also, AIDS projected prevalence for 2005 for these same cohorts was 1.4%, 1.9%, and 2.2% respectively.

The remainder of this paper will be organized as follows: section 2 will present the baseline model with its set up, equilibrium, and solution. Section 3 will calibrate the model as to make the results applicable to sub-Saharan Africa. Section 4 will bring the results, with section 5 concluding.

¹Some empirical cross-country evidence for this claim can be found in Fylkesnes et al. (2001) and Hargreaves et al. (2002).

2 Model

This model extends Corrigan, Glomm, and Mendez (2005) to include skill heterogeneity in the labor market. I will keep the notation similar to theirs as to facilitate comparison. The set up of the model is as follows.

2.1 Set Up

Each individual lives for a maximum of three periods: youth, adulthood, and old age. As adults, individuals will differ with respect to their skills. That is, an adult individual can either be skilled or unskilled. For the purposes of this paper, every skilled individual will carry a subscript of 1, while unskilled individuals will carry a subscript of 2. As individuals turn old, there will be no change in skill status. The only possibility to obtain skills in this model is by education at a young age. Educated children will become skilled workers; the opportunity cost of this education is labor income forgone in that particular period. I will assume that parents are the ones making educational decisions for their children. This way, the index assigned to children will be the same as their parents. Children, therefore, in this model can only work or learn.

However, this does not imply that as children transition to adulthood, they can't change status. For example, a child born in a skilled family could become an unskilled adult if the family decides that the child has to allocate the majority of its time to work. I will assume though that a child born in an unskilled household will remain unskilled as it enters adulthood. Since all of the model's dynamics stems from the decisions of the adult generation, in what follows, I will discuss their behavior in detail.

Starting in period 2, individual type i learns about his health status. I will assume that individuals are either healthy or unhealthy depending on their seroprevalence (HIV status). Let π_t^i be the probability of type i individual being infected at t , consequently $1 - \pi_t^i$ is the probability of remaining healthy. Note that this probability is conditional on skill type, which gives the model the flexibility to study how growth effects of the AIDS epidemic depend on cross-sectional correlations between incidence and socio-economic status.

Regardless of type or health status, all adult individuals will inelastically supply labor to the firm. Also, they will choose current consumption c_t , their children's con-

sumption f_t and education level n_t which will generate the level of the child's human capital in the future h_{t+1} . Healthy individuals will also choose how much to save s_t given some interest rate r_{t+1} so as to allow them to consume in the future c_{t+1} . Infected individuals will die after period 2 and therefore will not save; however, they need to choose how much to spend on HIV/AIDS related medical expenses m_t . Hence, healthy type i utility is given by,

$$U_i^h(c_t^i, f_t^i, c_{t+1}^i, h_{t+1}^i) = \alpha_1^i \ln c_t^i + \alpha_2^i \ln f_t^i + \alpha_3^i \ln c_{t+1}^i + \alpha_4^i \ln h_{t+1}^i, \quad (1)$$

and sick type i utility is given by,

$$U_i^s(c_t^i, f_t^i, m_t^i, h_{t+1}^i) = \frac{\alpha_1^i}{\rho^i} \ln[(c_t^i)^{\rho^i} + \theta^i (m_t^i)^{\rho^i}] + \alpha_2^i \ln f_t^i + \alpha_4^i \ln h_{t+1}^i. \quad (2)$$

Healthy adults of type i face the following budget constraint

$$c_t^i + f_t^i + s_t^i = (1 - \tau_t^i) w_t^i h_t^i + (1 - n_t^i) w_t^i h_t^i \Delta, \quad (3)$$

where τ_t is the government's income tax and Δ is a parameter that captures the degree of child's productivity relative to that of adults. Also, old age consumption c_{t+1} will be determined by,

$$c_{t+1}^i = (1 + r_{t+1}) s_t^i. \quad (4)$$

Sick adults of type i face a different budget given by,

$$c_t^i + f_t^i + \sigma_t p_t m_t^i = (1 - \tau_t^i) w_t^i h_t^i \Psi^i + (1 - n_t^i) w_t^i h_t^i \Delta, \quad (5)$$

where σ_t is the treatment subsidy provided by the government and p_t is the worldwide HIV medication price. The parameter Ψ^i measures the relative productivity of a sick individual relative to that of a healthy one.

Technology in this model is described by the following constant returns to scale production function,

$$Y_t = F(K_t, L_t^1, L_t^2) = [\eta (L_t^2)^\mu + (1 - \eta) (Q_t)^\mu]^{\frac{1}{\mu}}, \quad (6)$$

with

$$Q_t = [\delta(K_t)^\phi + (1 - \delta)(L_t^1)^\phi]^\frac{1}{\phi}, \quad (7)$$

where K_t is the aggregate capital stock, L_t^1 is the aggregate stock of effective skilled labor, L_t^2 is the aggregate stock of effective unskilled labor, and η and δ are parameters measuring the income shares of all inputs. The functional form for the technology above is a two level CES function with capital and skilled labor aggregated at the first level and then combined with unskilled labor at the second level. Duffy, Papageorgiou, and Perez-Sebastian (2004) have empirically shown that this technology is the most appropriate when confronted with cross country data. The parameters μ and ϕ were chosen as to impose capital-skill complementarity in the model, that is, $\phi < \mu$. Empirical support for the capital skill complementarity hypothesis can be found in Griliches (1969), Fallon and Layard (1975), and Krusell et al. (2000).

In addition to assuming capital-skill complementarity, the parameters μ and ϕ were chosen to make unskilled workers substitute for the capital-skill aggregate and skilled workers and capital complements, that is, $\mu \in (0, 1]$ and $\phi < 0$. Fallon and Layard (1975) have empirically estimated these parameters to be in the ranges hypothesized above for a sample of developing countries, and Zhou (2001) empirically concluded that unskilled and skilled labor are substitutes in a study of Zimbabwe. Also, anecdotal evidence for these hypotheses can be found in Amaral and Quintin (2004).

In order to completely characterize the technology above, one needs to define the expressions for skilled and unskilled labors. Effective skilled labor is composed of two types of labor: adult skilled healthy individuals and adult sick individuals. Assuming that the effective labor of an HIV infected skilled individual is a fraction ($\Psi^1 < 1$) of the effective labor of a healthy skilled individual, we have that

$$L_t^1 = [(1 - \pi_t^1) + \pi_t^1 \Psi^1] H_t^1, \quad (8)$$

where H_t^1 is the aggregate skilled human capital at time t . This assumption also implies that different types of skilled labor are perfect substitutes.

Perfect substitutability will also be assumed for the composition of unskilled labor. This input is composed of 6 types of labor: adult unskilled healthy individuals and their children, adult unskilled unhealthy individuals and their children, and the children of

both skilled healthy and skilled sick individuals. Here, I will also assume that the effective labor of an HIV infected unskilled individual is a fraction ($\Psi^2 < 1$) of the effective labor of a healthy unskilled individual. Also, I will assume that the effective labor of all children is a fraction ($\Delta < 1$) of the effective labor of a healthy unskilled individual. Hence, the equation for effective unskilled labor units is given by,

$$L_t^2 = [(1 - \pi_t^2)[1 + (1 - n_t^{2,h})\Delta] + \pi_t^2[\Psi^2 + (1 - n_t^{2,s})\Delta] + (1 - \pi_t^1)(1 - n_t^{1,h})\Delta + \pi_t^1(1 - n_t^{1,s})\Delta]H_t^2, \quad (9)$$

where H_t^2 is the aggregate unskilled human capital at time t , and $n^{i,j}$ is the fraction of type i, j ; where $i \in \{1, 2\}$ and $j \in \{h = \text{healthy}, s = \text{sick}\}$, children's time devoted to education.

The government will tax labor income of all adult types at a rate τ_t^i , but not the income of the children. As in Corrigan, Glomm, and Mendez (2005), this assumption captures the fact that children mostly work in the informal sector of the economy. It will use the proceeds to finance its own consumption and investment in some non-productive capital G_t ; and subsidize the price p_t of HIV medication M_t^i at rate σ_t , which will be taken as exogenous, in the form of ARV treatment. Also, the government will balance its budget every period; hence its budget equation is given by

$$G_t + (1 - \sigma_t) \sum_{i=1}^2 [p_t M_t^i] = \sum_{i=1}^2 [(\pi_t^i + (1 - \pi_t^i)\Psi^i)\tau_t^i w_t^i H_t^i]. \quad (10)$$

To finalize the set up of the model, one still needs to define the laws of motion for the children's human capital accumulation. Differently from Corrigan, Glomm, and Mendez (2005), I will assume that the child's human capital technology is only a linear function of time but not a function of the parent's human capital, that is,

$$h_{t+1}^{i,j} = B^{i,j} n_t^{i,j} \quad (11)$$

where $i \in \{1, 2\}$, $j \in \{h, s\}$, and B is a productivity parameter. This functional form will guarantee the model's tractability of aggregate human capital (H_t^i) without jeopardizing the results. Aggregate human capital will evolve according to:

$$H_{t+1}^1 = (1 - \pi_t^1)h_{t+1}^{1,h} \quad (12)$$

and

$$H_{t+1}^2 = \pi_t^2 h_{t+1}^{2,s} + \pi_t^1 h_{t+1}^{1,s} + (1 - \pi_t^2)h_{t+1}^{2,h}, \quad (13)$$

where children from healthy skilled parents will also be skilled, while all other children will be unskilled.

2.2 Equilibrium

In this section I will define all adults' maximization problems as well as the competitive equilibrium for this model. An adult individual will have a different maximization problem conditional on health status; however, the maximization problem is the same conditional on type. Hence for any type i healthy individual, the maximization problem will be to maximize (1) with respect to $\{c_t^i, f_t^i, s_t^i, n_t^i\}$ subject to equations (3), (4), and (11).

The maximization problem for HIV infected individuals of type i is to maximize (2) with respect to $\{c_t^i, f_t^i, m_t^i, n_t^i\}$ subject to equations (5) and (11). Given the maximization problems described above, a competitive equilibrium for this economy can be defined in the following manner:

Definition A competitive equilibrium for this economy are lists of household decisions $\{c_t^{i,h}, f_t^{i,h}, n_t^{i,h}, c_{t+1}^{i,h}\}_{t=0}^\infty$ for healthy individuals, $\{c_t^{i,s}, f_t^{i,s}, n_t^{i,s}, m_t^{i,s}\}_{t=0}^\infty$ for sick individuals, sequences of aggregate physical capital $\{K_t\}_{t=0}^\infty$, and effective labors $\{L_t^i\}$ for all $i \in \{1, 2\}$, such that, given sequences of prices $\{w_t^i, r_{t+1}, p_t\}_{t=0}^\infty$:

1. $\{c_t^{i,h}, f_t^{i,h}, n_t^{i,h}, c_{t+1}^{i,h}\}$ solve both skilled and unskilled healthy household problems,
2. $\{c_t^{i,s}, f_t^{i,s}, n_t^{i,s}, m_t^{i,s}\}$ solve both skilled and unskilled sick household problems,
3. the capital market clears, that is, $K_{t+1} = \sum_{i=1}^2 (1 - \pi_t^i) s_t^i$,
4. all human capital will evolve according to: $h_{t+1}^i = B^{i,j} n_t^{i,j}$ for all i and j ,
5. factor prices are determined by their respective factor demands' productivity, that is, $w_t^i = F_{L_t^i}$ and $r_t = F_{K_t}$,

6. and the government budget constraint is cleared every period, that is,

$$G_t + (1 - \sigma_t) \sum_{i=1}^2 [p_t M_t^i] = \sum_{i=1}^2 [(\pi_t^i + (1 - \pi_t^i) \Psi^i) \tau_t^i w_t^i H_t^i].$$

2.3 Solving the Model

Starting with a healthy individual, the first order conditions yield the following decision rules:

$$c_t^{i,h} = \frac{\alpha_1^i}{\alpha_1^i + \alpha_2^i + \alpha_3^i + \alpha_4^i} (1 - \tau_t^i + \Delta) w_t^i h_t^i, \quad (14)$$

$$f_t^{i,h} = \frac{\alpha_2^i}{\alpha_1^i + \alpha_2^i + \alpha_3^i + \alpha_4^i} (1 - \tau_t^i + \Delta) w_t^i h_t^i, \quad (15)$$

$$s_t^{i,h} = \frac{\alpha_3^i}{\alpha_1^i + \alpha_2^i + \alpha_3^i + \alpha_4^i} (1 - \tau_t^i + \Delta) w_t^i h_t^i, \quad (16)$$

and

$$n_t^{i,h} = \frac{\alpha_4^i}{\alpha_1^i + \alpha_2^i + \alpha_3^i + \alpha_4^i} \left[\frac{(1 - \tau_t^i + \Delta)}{\Delta} \right]. \quad (17)$$

The solutions to s_t^i and n_t^i yield:

$$c_{t+1}^i = (1 + r_{t+1}) \frac{\alpha_3^i}{\alpha_1^i + \alpha_2^i + \alpha_3^i + \alpha_4^i} (1 - \tau_t^i + \Delta) w_t^i h_t^i, \quad (18)$$

and

$$h_{t+1}^{i,h} = B^{i,h} \frac{\alpha_4^i}{\alpha_1^i + \alpha_2^i + \alpha_3^i + \alpha_4^i} \left[\frac{(1 - \tau_t^i + \Delta)}{\Delta} \right], \quad (19)$$

which are the decision rules for old age consumption and human capital. Since sick individuals do not save in this model, the law of motion for aggregate capital can be written as

$$K_{t+1} = \sum_{i=1}^2 [(1 - \pi_t^i) \frac{\alpha_3^i}{\alpha_1^i + \alpha_2^i + \alpha_3^i + \alpha_4^i} (1 - \tau_t^i + \Delta) w_t^i H_t^i]. \quad (20)$$

For sick individuals the first order necessary conditions from their maximization problem yields:

$$c_t^{i,s} = \frac{\alpha_1^i}{[\alpha_1^i + \alpha_2^i + \alpha_4^i]} \frac{[(1 - \tau_t^i)\Psi^i + \Delta]}{[1 + \theta^{\frac{1}{1-\rho^i}} (\sigma_t p_t)^{\frac{\rho^i}{1-\rho^i}}]} w_t^i h_t^i, \quad (21)$$

$$f_t^{i,s} = \frac{\alpha_2^i}{\alpha_1^i + \alpha_2^i + \alpha_4^i} [(1 - \tau_t^i)\Psi^i + \Delta] w_t^i h_t^i, \quad (22)$$

$$n_t^{i,s} = \frac{\alpha_4^i}{[\alpha_1^i + \alpha_2^i + \alpha_4^i]} \frac{[(1 - \tau_t^i)\Psi^i + \Delta]}{\Delta}, \quad (23)$$

which implies that

$$h_{t+1}^{i,s} = B^{i,s} \frac{\alpha_4^i}{[\alpha_1^i + \alpha_2^i + \alpha_4^i]} \frac{[(1 - \tau_t^i)\Psi^i + \Delta]}{\Delta}. \quad (24)$$

Also, the solution to medical expenses demand is given by

$$m_t^i = \frac{\alpha_1^i}{[\alpha_1^i + \alpha_2^i + \alpha_4^i]} \frac{\theta^{\frac{1}{1-\rho^i}} (\sigma_t p_t)^{\frac{1}{1-\rho^i}}}{[1 + \theta^{\frac{1}{1-\rho^i}} (\sigma_t p_t)^{\frac{\rho^i}{1-\rho^i}}]} [(1 - \tau_t^i)\Psi^i + \Delta] w_t^i h_t^i, \quad (25)$$

which makes the economy-wide expenditures on medical services equal to

$$p_t M_t = \sum_{i=1}^2 \pi_t^i \frac{\alpha_1^i}{[\alpha_1^i + \alpha_2^i + \alpha_4^i]} \frac{\theta^{\frac{1}{1-\rho^i}} (\sigma_t p_t)^{\frac{1}{1-\rho^i}}}{[1 + \theta^{\frac{1}{1-\rho^i}} (\sigma_t p_t)^{\frac{\rho^i}{1-\rho^i}}]} [(1 - \tau_t^i)\Psi^i + \Delta] w_t^i h_t^i. \quad (26)$$

With the decision rules regarding time spent on education, aggregate human capital accumulation will be given by equations (12) and (13), with h_{t+1}^i replaced by equations (19) and (24).

Note that some of the decision rules above still depend on the wage rate w_t^i or the subsidy rate σ_t and all other exogenous forces. The subsidy σ_t can be solved from the government's budget constraint (10) for any fixed value of p_t , G_t , and w_t^i ; given all other exogenous parameters. Hence, determining the wage rates for both skilled and unskilled individuals completely solves the model.

The wage rates can be obtained from the first order condition of the firm's problem, where each wage will equal its marginal product, that is

$$w_t^1 = \frac{(1 - \eta)(1 - \delta)[\eta(L_t^2)^\mu + (1 - \eta)(Q_t)^\mu]^{\frac{1-\mu}{\mu}} Q_t^{\mu-\phi}}{(L_t^1)^{1-\phi}} \quad (27)$$

and

$$w_t^2 = \frac{\eta[\eta(L_t^2)^\mu + (1 - \eta)(Q_t)^\mu]^{\frac{1-\mu}{\mu}}}{(L_t^2)^{1-\mu}}, \quad (28)$$

where Q_t , L_t^1 , and L_t^2 are given by equations (7), (8), and (9) respectively.

3 Calibration

The parameters chosen for the simulations reflect roughly the economy of sub-Sahara Africa. Table 2 contains the baseline calibrated values. As in Corrigan, Glomm, and Mendez (2005), I impose no preference heterogeneity and choose the same parameter values as they have for all utility functions in my model. I also follow Corrigan, Glomm, and Mendez (2005) in my choices for taxes, and labor productivity parameters. The choice of the labor productivity parameter Ψ is also consistent with Cuddington (1993a) for the economy of Tanzania as well as Guinness and Alban (2000). Human capital productivity is assumed to be the same across agents making human capital accumulation only dependent on the parents choice of its children schooling. Sensitivity analysis will be performed on Ψ^i , Δ , and $B^{i,j}$ since the results could be sensitive to the choice of these parameters.

The income share parameters η and δ are calibrated using a combination of data and previous studies on sub-Saharan African economies. Gollin (2002) estimated income shares for a cross section of countries and using his results for sub-Saharan African countries only, the income share due to labor can be roughly calculated to be 0.65 (0.35 for capital). To determine what fraction of the labor income share is due to skilled labor versus unskilled, I use the World Development Indicators database for a poll of sub-Saharan African countries² where data on education was available between the years 1996 and 2008. I assume all individuals that at least completed secondary education were skilled, which is consistent with Fallon and Layard (1975), otherwise I put them in the unskilled category. Using each country's labor force as weights, I compute the labor fractions to be 0.37 for skilled and 0.63 for unskilled. In order to determine how much each type contributes to income, I assume a wage skill premium of 3 to 1 (Mwabu and Schultz (2000)) and obtain income shares to be 0.23 for unskilled

²The list of countries used was: Ethiopia, Botswana, Ghana, Guinea, Kenya, Lesotho, Madagascar, Mauritius, Namibia, Nigeria, Rwanda, South Africa, Tanzania, Uganda, and Zambia.

workers and 0.42 for skilled workers. This implies that $\eta = 0.23$ since η is the coefficient that corresponds to the unskilled labor share of income. The capital share of income is 0.35, which according to the production function should equal to $(1 - \eta)\delta$. Hence, δ can be derived to be 0.45.

As mentioned before, the parameters μ and ϕ are selected to capture capital-skill complementarity ($\mu > \phi$). In addition, μ is chosen to capture some degree of substitutability between unskilled labor and the capital-skill aggregate, and ϕ is chosen as to impose complementarity between skilled workers and capital. Another important feature in the choice of these parameters is that they are selected as to ensure that the model generates a wage skill premium of at least 2. Extensive sensitivity analysis was performed on these parameters since they play a very important role in the model.

4 Computational Experiments and Results

The purpose of this section is to compute transition paths for different scenarios where AIDS affects the economy and compare output across these states relative to a hypothetical no-AIDS case. Five scenarios were computed and in all the simulations, I will let the model reach a steady state no-AIDS output first and then impose a positive probability of infection that will vary across skills. The economy will evolve for 10 periods and output will be reported as a percentage of the no-AIDS steady state for every generation after the shock.

The model's share of skilled versus unskilled labor was used in order to compute the infection probabilities as to keep the overall infection rate constant in each scenario. Letting the disease distribution vary across skills, but keeping the mean overall infection rate the same; that is, using mean preserving spreads, allows for an analysis of how the distribution of the disease across skills affects the economy. It will be possible then to investigate if there are any significant differences in the effect of AIDS on output as one moves from a case where only skilled people are infected to a case where only unskilled people are infected given the same overall infection level.

In the first 2 scenarios with AIDS, I have chosen to keep HIV infection around 7%, which corresponds to the current average HIV infection prevalence in sub-Saharan Africa (World Development Indicators) weighted by each country's population where

data is available³. In the next 2 scenarios the overall infection probability is 20%, which corresponds to the levels of infection reported in southern Africa in countries like South Africa, Botswana, Lesotho, Namibia, and Zambia. Hence, it seems appropriate to investigate scenarios where the overall probability is quite high. Scenarios 1 and 3 are attempts to compute the effects of AIDS on output in a situation where there is no cure or reduction in infection rates. These scenarios could be considered worst case scenarios. Scenarios 2 and 4 assumes AIDS will no longer be a problem after 2 generations.

The following scenarios were considered in this experiment:

1. Scenario 1: At $t = 20$, the overall infection probability is 7% and remains at this level forever. Five variations of this scenario were chosen with respect to π^1 and π^2
 - (a) $\pi^1 = 0$ and $\pi^2 = 0.129$
 - (b) $\pi^1 = 0.035$ and $\pi^2 = 0.1$
 - (c) $\pi^1 = \pi^2 = 0.07$
 - (d) $\pi^1 = 0.1$ and $\pi^2 = 0.044$
 - (e) $\pi^1 = 0.152$ and $\pi^2 = 0$
2. Scenario 2: At $t = 20$ and $t = 21$, the overall infection probability is 7% and returns to zero after that. The same five variations as above were chosen for π^1 and π^2 here.⁴
3. Scenario 3: At $t = 20$, the overall infection probability is 20% and remains at this level forever. Five variations of this scenario were chosen with respect to π^1 and π^2
 - (a) $\pi^1 = 0$ and $\pi^2 = 0.356$
 - (b) $\pi^1 = 0.10$ and $\pi^2 = 0.269$
 - (c) $\pi^1 = \pi^2 = 0.20$
 - (d) $\pi^1 = 0.295$ and $\pi^2 = 0.10$

³HIV prevalence data from the World Development Indicators is available for the following countries: Ethiopia, Botswana, Ghana, Guinea, Kenya, Lesotho, Namibia, Nigeria, Rwanda, South Africa, Tanzania, Uganda, and Zambia

⁴I will refer to each probability combination similarly to how I refer under scenario 1; that is, case 2a to case 2e.

- (e) $\pi^1 = 0.41$ and $\pi^2 = 0$
4. Scenario 4: At $t = 20$ and $t = 21$, the overall infection probability is 20% and returns to zero after that. The same five variations as in scenario 3 were chosen for π^1 and π^2 here.⁵
5. Scenario 5: At $t = 20$, $\pi^1 = 0.08$ and $\pi^2 = 0.024$; at $t = 21$, $\pi^1 = 0.05$ and $\pi^2 = 0.31$. After $t = 21$, all infection rates return to zero.

Scenario 5 captures the effect of AIDS whenever the epidemic curve differs in timing across skills, that is, the epidemic affects skilled individuals more heavily first relative to unskilled and then switches to affecting the unskilled more relative to skilled. That is, the two epidemiological curves should cross at some point. It is also assumed that, in this scenario, the overall level of infection increases from 5% to 20% in subsequent generations. This fifth scenario is consistent with Vandermoortele and Delamonica (2000) and with evidence presented in Hargreaves et al. (2002) using demographic health survey data for an urban population in Kenya where the argument is that once the epidemic becomes more widespread, it will affect unskilled individuals more relative to skilled since the latter have the means to protect themselves against the disease as they learn how AIDS is transmitted. In fact, empirical studies have shown the positive association between education, which is often used as a proxy for socioeconomic status, and safer sexual behavior (de Walque (2006)).

The study of the effects of AIDS under these different scenarios can help in answering some important questions. For example, under scenarios 1 and 3, one can investigate the economy's transition path towards a new output steady state compared to the no-AIDS case. Scenarios 2 and 4 permits one to investigate how long would it take for an economy to recuperate from the epidemic. For purposes of interpretation, I will define the short/medium run as generations 1 to 3 and the long-run as generation 5 and above. While, scenarios 1 and 2 can assist in predicting what future damages AIDS can still cause giving the current situation (7% or 20% prevalence), scenario 5 can assist in understanding the course of the epidemic and its effect on output since the advent of the disease in the late seventies and early eighties.

⁵I will refer to each probability combination similarly to how I refer under scenario 3; that is, case 4a to case 4e.

Before analyzing each scenario in detail, one way to assess the model’s overall goodness of fit is to compare its predictions about the skill premium with that of data. Mwabu and Schultz (2000) report skill premiums for South Africa ranging between 2 and 5. Figures 1 to 5 display the skill premiums generated by the model for each scenario before and after the epidemic. In almost all cases the skill premiums generated by the model are consistent with Mwabu and Schultz (2000).

Table 3 presents the results for the baseline parameter values for all scenarios. Under scenario 1, which imposes an overall infection probability of 7%, AIDS reduces output in the first generation by 1.3% for the case where $\pi^1 = 0$ and $\pi^2 = 0.129$, 2.15% for the case where $\pi^1 = \pi^2 = 0.07$, and 3.2% when $\pi^2 = 0$ and $\pi^1 = 0.152$. From generation 1 to generation 2, the epidemic has its greatest dive with the effect ranging from 2.8% (case 1a) to 9.6% (case 1e) of output. This happens because capital is mostly affected in generation 2. The fact that the epidemic is more severe in cases where skilled people are affected harder has been explained above. After the second generation output stabilizes and by generation 10, the effect ranges from 3.6% to 9.4% of output. These results are very similar to Cuddington and Hancock (1995).

Scenario 3 is qualitative similar to scenario 1. However, since the overall infection probability is much higher (20%), the effects are much larger. In generation 1, output decreases by 3.8% for case 3a and 9% for case 3e. In the long-run output will settle from 10.5% to 27.4% below the no-AIDS scenario. The variability across cases is alarming and suggests that the long-run effects of AIDS are very sensitive to how the disease is distributed across skills. The magnitude of these results are very much in line with Cuddington (1993a), Cuddington (1993b), Botswana Institute for Development Policy Analysis (2000), and Arndt (2003). As explained above, the fact that the results are very sensitive to the prevalence across skills can be attributed to physical capital accumulation. Whenever, the epidemic is more prevalent among skilled individuals, and given that these individuals are the greatest contributors to saving, physical capital will be very much affected if a larger proportion of these individuals are sick.

Figures 6 and 7 display the difference in output between each case under scenarios 1 and 3 and the no AIDS case relative to the difference in output between the case where AIDS incidence is the same across skills and the no AIDS case⁶. Two conclusions

⁶This metric was not calculated for scenarios 2 and 4 because the epidemic is temporary and therefore

stems from these figures; first the effect of the epidemic varies significantly across cases as case (a) in both scenarios lies 60% above the benchmark (case (c)), while case (e) lies 40% below the benchmark case. Second, it appears that changing the overall level of infection does not introduce significant variations across cases, that is, both figures are very much alike with respect to shape and magnitudes.

Another way to compare the difference between each case for every scenario relative to the no AIDS case is to compute the total sum of squared differences (TSS) between the output generated in each case and the output under the no AIDS case and compare the magnitude of the value across cases. Table 6 has these results for scenarios 1 to 4. In every scenario, there is a monotonic increasing relationship between TSS and cases. That is, increasing the AIDS prevalence among skilled relative to unskilled people, increases the magnitude of the effect of AIDS on output.

Scenarios 2 and 4 behaves exactly like scenarios 1 and 3 for the first 2 generations after the start of the epidemic. Since in these scenarios, the disease no longer exists after 2 generations, they can be used to assess how long it would take for recovery. In both scenarios, recovery starts in generation 3, however, very modestly. This is due to the fact that the accumulation of physical capital will only significantly increase during generation 4 because it takes one generation for a reduction in π to affect physical capital (see equation 20). It will be between generations 4 and 5 that in most cases output will have almost recovered. Assuming each generation is about 20 years, this model indicates that it would take sub-Sahara Africa between 80 to 100 years to recover.

Scenario 5, which imposes the hypothesis that the epidemic switches from being higher among skilled to being higher among unskilled individuals, suggests that while infection rates are still low and mainly affecting skilled workers, output will be 1.9% lower. The greatest effect will be felt during generation 2, with output 7.7% below the no-AIDS scenario. The economy starts to recover after that and, similarly to scenarios 2 and 4, would take 5 generations for the economy to recover.

In order to understand each scenario in more detail, it is important to investigate how each affected variable affects output in the advent of the epidemic, that is, in which direction and in what strength will output move as skilled labor, unskilled labor, and capital is affected by AIDS.

after 5 generations, the ratio cannot be calculated as both the numerator and denominator become zero.

Given the calibrated parameters, the steady state wage rate of skilled workers is greater than the steady state wage rate of unskilled workers, that is, $w_{ss}^1 > w_{ss}^2$. Also, it is easy to verify that around the steady state $r_{ss} > w_{ss}^1$ since $K_{ss} < [\frac{\delta}{1-\delta}]^{\frac{1}{(1-\phi)}} L_{ss}^1$, which implies that changes in capital provide the greatest contribution to output, followed by skilled labor and unskilled labor respectively.

In the model, AIDS affects the economy through $\pi^1 > 0$ and/or $\pi^2 > 0$; hence, it is important to understand how changes in these parameters affect the factors of production. Since the effects of AIDS on all of the aggregate variables and wages either increase or decrease as one moves from case (a) to (e), that is, the relationship is monotonic with respect to cases; there is no need to show the transition paths for all five cases, therefore I only report the transition paths for the two extreme cases where AIDS only affects skilled or unskilled individuals and the case where AIDS prevalence is the same across skills. I have also chosen not to report the transition paths for scenarios 3 and 4 since the results would only change in levels. Hence, without loss of generality, tables 4 and 5 shows the transition paths of all aggregate variables and wages after the AIDS shock for cases (a), (c), and (e) of scenarios 1 and 2. These tables can assist in disentangling the effects of AIDS on output.

It is easy to verify that there are two channels at which π^1 affects L^1 . A direct channel and an indirect channel, through H^1 , given by equations (8) and (12) respectively. However, these effects will come at different generations since H^1 will only be affected in the following period since aggregate human capital today is only affected by yesterday's infection probabilities. This implies that a one time increase in π^1 decreases skilled labor for 2 generations. After the second generation, effective skilled labor returns to the same level as before the shock. In table 5, the reason why skilled labor only returns to the same level as before the beginning of the epidemic in generation 4, is because AIDS affected the economy for 2 generations. Also, in table 4, skilled labor never returns to the pre-AIDS level because the epidemic is present forever; however, it adjusts to the new level by the second generation.

The equation determining effective unskilled labor is more complicated because it depends on both infection probabilities as well as effective unskilled human capital, which in turn depends on both π^1 and π^2 . As with skilled labor, a one time change in any infection probability will affect unskilled labor for 2 generations. The direction

of this effect will depend on the distribution of AIDS prevalence across skills. For the cases where AIDS only affects unskilled individuals, effective unskilled labor will behave exactly the same way as skilled labor did in the explanation above. Whenever AIDS only affects skilled people, unskilled labor will increase for 2 generations and then return back to the pre-AIDS level. During generation 1, an increase in π^1 will increase L^2 because $n^{1,h} > n^{1,s}$, that is, children of infected skilled parents work more than children from uninfected skilled parents. Also, the children from infected skilled workers will increase aggregate unskilled human capital (equation 13) causing effective unskilled labor to increase in generation 2. The case in which both skills are affected causes L^2 to decrease in generation 1 as the effect caused by $\Psi^2 < 1$ dominates $n^{1,h} > n^{1,s}$, and increase in generation 2 as the effect of π^1 on H^2 is greater than the effect of π^2 on H^2 . These results can be easily verified from equation (13). The behavior of L^2 can be verified for these three cases in tables 4 and 5 with the epidemic affecting the economy forever and for only 2 generations respectively.

Physical capital depends directly on the probability of infection π^1 and π^2 as well as wages and aggregate human capital (equation 20). As with aggregate human capital, it takes one generation for physical capital to be affected by the epidemic. It is easy to check that increases in infection probabilities and decreases in wages and human capital will cause capital to decrease. Since it is never the case that all wages and all human capital move in the same direction, it might not be possible to determine unambiguously how capital moves after the AIDS shock. However, for the cases analyzed in this paper, the effect on capital of changes in infection probabilities always dominates any other effect; hence, capital will always decrease one generation after AIDS affects the economy. Also, since the model generates a skill premium in the order of 2, the proportion of total savings that can be attributed to skilled workers is larger; therefore, capital will be more greatly affected whenever the epidemic hits skilled people more relative to unskilled. This fact combined with the condition that changes in capital causes the greatest changes in output, explains why in table 3 output is smaller for the cases where the epidemic is more prevalent among skilled workers.

Note that a one time increase in the infection probability can cause capital to move for more than 2 subsequent generations. That is, it takes longer for capital to adjust. Tables 4 and 5 can help in assessing this finding. Even though, in all of the scenarios

investigated in this paper the probability of infection lasts for at least 2 generations, skilled and unskilled labor either adjust to a new level or return to the pre-AIDS level much faster than capital. The fact that there is a dynamic relationship between capital and wages explains this behavior. Hence, once the epidemic begins, wages are affected because labor is affected (equations 27 and 28). These wages will affect capital next period and capital next period will affect wages in that same period, which in turn will affect capital in the subsequent period.

Two interconnected results stem from scenarios 2 and 4. First, it seems that even though the epidemic will more greatly affect output in cases where HIV infects skilled workers more relative to unskilled, it will also recover faster in those cases. Second, whenever the epidemic affects skilled workers more relative to unskilled, output can overshoot and stay for sometime above the no-AIDS scenario. These results can be explained by looking at table 5 and observing the behavior of skilled wage, skilled labor, skilled human capital, and physical capital for the case where $\pi^1 = 0.152$ and $\pi^2 = 0$. As the epidemic struck during generation 1, skilled labor fell pushing its wage up. Skilled human capital and physical capital fell drastically by generation 2. The decrease in H^1 caused L^1 to decrease even further, which pushed w^1 even higher. When the epidemic was over in generation 3, skilled labor recovered but not to the level before AIDS since it would take one more generation for H^1 to recover. This caused w^1 to decrease, but to remain above its pre-AIDS level. Hence, physical capital increased above its pre-AIDS level causing output to do the same. This does not happen in other cases because the decrease in π^1 is not large enough as to make capital jump as much and have the skilled wage effect large enough to dominate the unskilled wage effect. It is because of these dynamics that one can see output recovering faster and overshooting in cases where more skilled workers are infected.

Sensitivity analysis was performed with respect to parameters Ψ^i , Δ , $B^{i,j}$, μ , and ϕ ; and all results were reported in tables 7 to 21. Overall, the results are not very sensitive to the choice of most of these parameters.

The parameter Ψ^i measures the work productivity of an infected individual relative to that of a healthy individual. Since the baseline model assumes $\Psi^1 = \Psi^2 = 0.5$, it seems reasonable to investigate two issues. First, changes in Ψ^1 and Ψ^2 will be chosen as to keep $\Psi^1 = \Psi^2$, but for levels not equal to 0.5. Second, Ψ^1 will be chosen to be

relativitily higher than Ψ^2 in order to capture the possibility that skilled individuals are more capable to treat themselves, hence, not losing as much in productivity compared to a healthy individual. The parameter Ψ^1 was chosen to range from 0.4 to 0.54⁷, while Ψ^2 was chosen to vary from 0.4 to 0.5. Reducing the values of both Ψ^1 and Ψ^2 to 0.4 is consistent with the findings in Guinness and Alban (2000). All results are reported on tables 7 to 9. All scenarios seems robust to the choice of Ψ^1 and Ψ^2 with maximum variation for any given case in the order of 1 percentage point.

The results are also very robust to the choice of parameter Δ (tables 10 to 12) with maximum variation for any given case in the order of 1 percentage point. The same result is true for different choices of the parameters B^{ij} (tables 13 to 15), which measures the efficiency of school training.

The results from sensitivity analysis performed on the parameter μ , which captures the degree of substitutability between unskilled labor and the capital-skill aggregate, are displayed in tables 16 to 18. The effect of the epidemic on output is very insensitive to μ in scenario 3 (table 18). In scenarios 1 and 2 (tables 16 and 17), the results only become sensitive for μ values above 0.1. That is, for these large values, the effect of the epidemic on output presents almost no variation across all five cases. However, increasing μ has a negative effect on the skill premium. This is due to the fact that around the steady state, the ratio between Q and L^2 is less than one.⁸ Because the skill premium falls below 2 as μ is set above 0.0295 and there is some evidence indicating that in sub-Saharan Africa this premium should be between 2 and 5 (Mwabu and Schultz (2000)), I can restrict the parameter μ to range between zero and 0.03. Therefore, for this imposed range, the results are quite robust to the choice of μ .

Tables 19, 20, and 21 has the results for different ϕ values. This parameter captures the degree of complementarity between capital and skilled labor. The results seems very robust to the choice of ϕ values.

⁷I have restricted Ψ^1 to 0.54 as to guarantee that $n^{1,h} > n^{1,s}$ always happens.

⁸The skill premium $\frac{w^1}{w^2}$ can be expressed as: $\frac{(1-\eta)(1-\delta)}{\eta} \frac{L^2}{Q^\phi (L^1)^{(1-\phi)}} (\frac{Q}{L^2})^\mu$. Hence, whenever $Q < L^2$, as μ increases, the skill premium decreases.

5 Conclusion

This paper investigated the effects of HIV/AIDS on steady state output for an economy resembling sub-Saharan Africa with skill heterogeneity. Assuming different effects of the AIDS epidemic across skills, I find the results to be sensitive to the distribution of the disease across skills. In a scenario where the overall infection rate is permanently at 7%, output settles after generation 3 at 3.5% below steady state no-AIDS output for the case where AIDS only affects unskilled workers. This same result jumps to 10% whenever AIDS only affects skilled workers. For any different combination of infection probability across skills, the results are between the above numbers. Hence the relationship between the effect of AIDS on output and the distribution of AIDS across skills is monotonic. For a similar scenario, where the overall probability was set at 20%, the effect of AIDS on output ranged from 10% to 28% after generation 3.

For scenarios where the epidemic is over after 2 generations, it takes between 4 to 5 generations for the economy to recover. Assuming each generation encompasses 20 years, this corresponds to a recovery time in the order of 80 to 100 years. Most of the results were not sensitive to the choice of parameters.

There are some extensions of this paper that might be of some importance. First, one might want to endogeneize the labor productivity parameters as to make it a function of each individual demand for medication. This could potentially assist in answering questions about governmental policy with respect to subsidy levels and its distribution across skills and how could changes in these policies affect output. Also, one could endogeneize infection probabilities making them a function of some prevention policy parameter. This could help answering questions about optimal governmental policy, that is, what is the best combination of prevention and treatment in order to minimize the effect of the epidemic. I leave these questions for a different paper.

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A Tables and Figures

Table 1: Review of the Effect of HIV/AIDS on Economic Growth

Paper	Model Type	Country/Region	Result
Over (1992)	Regression - 2 sectors	30 sub-Saharan African	Annual GDP growth 0.56 to 1.47% lower
Kambou, Devarajan, and Over (1992)	CGE - 11 sectors	Cameroon	Annual GDP growth 0 to 1.9% lower
Cuddington (1993a)	Solow type	Tanzania	GDP 15 to 25% smaller
Cuddington (1993b)	Solow type - 2 sectors	Tanzania	GDP 15 to 25% smaller
Cuddington and Hancock (1994)	Solow type	Malawi	Annual GDP growth 0.2 to 1.5% lower
Cuddington and Hancock (1995)	Solow type - 2 sectors	Malawi	GDP 3 to 9% smaller
Bloom and Mahal (1997)	Regression	51 countries worldwide	Insignificant effect on per capita income growth
Bonnel (2000)	Regression	50 African countries	Annual GDP growth 0.7 to 1.1% lower
Arndt and Lewis (2000)	CGE	South Africa	Annual GDP growth 2.6 percentage points lower
BIDPA (2000)	CGE and Solow type	Botswana	Overall economy 24 to 38% smaller
World Bank (2000)	Solow type	Lesotho	Annual GDP growth 0.8% lower
World Bank (2001)	Solow type	Swaziland	Annual GDP growth 1.5% lower
World Bank (2001)	Solow type	Namibia	Annual GDP growth 1.1% lower
Dixon, McDonald, and Roberts (2001)	Regression - panel data	41 African countries	GDP growth 2 to 4% smaller
Arndt (2003)	CGE	Mozambique	GDP 14 to 20% smaller
Bell (2003)	OLG - calibration	South Africa	Possible economic collapse in 3 to 4 generations
Corrigan, Glomm, and Mendez (2005)	OLG - calibration	Sub-Sahara Africa	Long-run GDP growth 0 to 10% lower

Table 2: Calibrated Parameter Values for Baseline Model

Parameter Value	Data Moment	Source
Preferences		
$\alpha_1 = 1$		Corrigan, Glomm, and Mendez (2005)
$\alpha_2 = 0.4$		Corrigan, Glomm, and Mendez (2005)
$\alpha_3 = 1$		Corrigan, Glomm, and Mendez (2005)
$\alpha_4 = 0.2$		Corrigan, Glomm, and Mendez (2005)
$\theta = 0.05$	Private health care expenditure	Corrigan, Glomm, and Mendez (2005)
$\rho = -0.5$	Private health care expenditure	Corrigan, Glomm, and Mendez (2005)
Taxes		
$\tau^1 = \tau^2 = 0.2$		Corrigan, Glomm, and Mendez (2005)
Production Function		
$\eta = 0.23$	Factors income share	Gollin (2002)
$\delta = 0.45$	Factors income share	Gollin (2002)
$\mu = 0.01$	Wage skill premium	Fallon and Layard (1975)
$\phi = -0.025$	Wage skill premium	Fallon and Layard (1975)
Labor Productivity		
$\Psi^1 = \Psi^2 = 0.5$	Proportion sick days due to AIDS	Cuddington (1993a)
$\Delta = 0.15$	Relative wage income from child labor	Corrigan, Glomm, and Mendez (2005)

Table 3: Output Levels Relative to no AIDS Scenario (in %) for all Scenarios under the Baseline Calibration

Scenario 1							
Period	0	1	2	3	4	5	10
no AIDS	100	100	100	100	100	100	100
$\pi^1 = 0, \pi^2 = 0.129$	100	98.69	97.14	96.67	96.50	96.44	96.40
$\pi^1 = 0.035, \pi^2 = 0.10$	100	98.27	95.74	95.40	95.28	95.24	95.21
$\pi^1 = \pi^2 = 0.07$	100	97.85	94.26	94.06	93.99	93.96	93.95
$\pi^1 = 0.10, \pi^2 = 0.044$	100	97.49	92.92	92.84	92.80	92.79	92.78
$\pi^1 = 0.152, \pi^2 = 0$	100	96.81	90.41	90.51	90.55	90.57	90.57
Scenario 2							
Period	0	1	2	3	4	5	10
no AIDS	100	100	100	100	100	100	100
$\pi^1 = 0, \pi^2 = 0.129$	100	98.69	97.14	97.96	99.34	99.76	99.99
$\pi^1 = 0.035, \pi^2 = 0.10$	100	98.27	95.74	97.08	99.50	99.82	100
$\pi^1 = \pi^2 = 0.07$	100	97.85	94.26	96.12	99.70	99.89	100
$\pi^1 = 0.10, \pi^2 = 0.044$	100	97.49	92.92	95.23	99.91	99.97	100
$\pi^1 = 0.152, \pi^2 = 0$	100	96.81	90.41	93.50	100.35	100.13	100
Scenario 3							
Period	0	1	2	3	4	5	10
no AIDS	100	100	100	100	100	100	100
$\pi^1 = 0, \pi^2 = 0.356$	100	96.22	91.72	90.32	89.81	89.63	89.52
$\pi^1 = 0.10, \pi^2 = 0.269$	100	95.17	88.03	87.30	87.03	86.94	86.88
$\pi^1 = \pi^2 = 0.20$	100	93.80	83.15	82.96	82.89	82.86	82.85
$\pi^1 = 0.295, \pi^2 = 0.10$	100	92.71	78.48	78.79	78.90	78.94	78.97
$\pi^1 = 0.41, \pi^2 = 0$	100	91.01	71.44	72.19	72.46	72.56	72.61
Scenario 4							
Period	0	1	2	3	4	5	10
no AIDS	100	100	100	100	100	100	100
$\pi^1 = 0, \pi^2 = 0.356$	100	96.22	91.72	93.87	97.97	99.26	100
$\pi^1 = 0.10, \pi^2 = 0.269$	100	95.17	88.03	91.73	98.69	99.52	100
$\pi^1 = \pi^2 = 0.20$	100	93.80	83.15	88.45	99.64	99.87	100
$\pi^1 = 0.295, \pi^2 = 0.10$	100	92.71	78.48	84.99	101.07	100.39	100
$\pi^1 = 0.41, \pi^2 = 0$	100	91.01	71.44	79.33	103.23	101.16	100
Scenario 5							
Period	0	1	2	3	4	5	10
no AIDS	100	100	100	100	100	100	100
AIDS	100	98.10	92.33	94.24	98.80	99.56	100

Table 4: Transition Paths after AIDS shock for all Aggregate Variables and Wages under Scenario 1 (all variables normalized to 100 at $t = 0$)

Period		0	1	2	3	4	5	10
Y	$\pi^1 = 0, \pi^2 = 0.129$	100	98.69	97.14	96.67	96.50	96.44	96.40
	$\pi^1 = \pi^2 = 0.07$	100	97.85	94.26	94.06	93.99	93.96	93.95
	$\pi^1 = 0.152, \pi^2 = 0$	100	96.81	90.41	90.51	90.55	90.57	90.57
L^1	$\pi^1 = 0, \pi^2 = 0.129$	100	100	100	100	100	100	100
	$\pi^1 = \pi^2 = 0.07$	100	96.50	89.75	89.75	89.75	89.75	89.75
	$\pi^1 = 0.152, \pi^2 = 0$	100	92.40	78.36	78.36	78.36	78.36	78.36
L^2	$\pi^1 = 0, \pi^2 = 0.129$	100	94.46	93.74	93.74	93.74	93.74	93.74
	$\pi^1 = \pi^2 = 0.07$	100	97.02	103.01	103.01	103.01	103.01	103.01
	$\pi^1 = 0.152, \pi^2 = 0$	100	100.06	114.37	114.37	114.37	114.37	114.37
K	$\pi^1 = 0, \pi^2 = 0.129$	100	100	96.16	94.85	94.38	94.21	94.12
	$\pi^1 = \pi^2 = 0.07$	100	100	94.17	93.60	93.39	93.32	93.28
	$\pi^1 = 0.152, \pi^2 = 0$	100	100	91.50	91.81	91.92	91.96	91.98
w_1	$\pi^1 = 0, \pi^2 = 0.129$	100	98.70	97.11	96.62	96.45	96.38	96.34
	$\pi^1 = \pi^2 = 0.07$	100	101.45	105.07	104.83	104.74	104.72	104.70
	$\pi^1 = 0.152, \pi^2 = 0$	100	104.86	115.51	115.65	115.70	115.72	115.73
w_2	$\pi^1 = 0, \pi^2 = 0.129$	100	104.43	103.60	103.10	102.92	102.85	102.82
	$\pi^1 = \pi^2 = 0.07$	100	100.85	91.59	91.40	91.33	91.30	91.29
	$\pi^1 = 0.152, \pi^2 = 0$	100	96.79	79.24	79.33	79.36	79.37	79.38
H^1	$\pi^1 = 0, \pi^2 = 0.129$	100	100	100	100	100	100	100
	$\pi^1 = \pi^2 = 0.07$	100	100	93.00	93.00	93.00	93.00	93.00
	$\pi^1 = 0.152, \pi^2 = 0$	100	100	84.80	84.80	84.80	84.80	84.80
H^2	$\pi^1 = 0, \pi^2 = 0.129$	100	100	99.24	99.24	99.24	99.24	99.24
	$\pi^1 = \pi^2 = 0.07$	100	100	106.17	106.17	106.17	106.17	106.17
	$\pi^1 = 0.152, \pi^2 = 0$	100	100	114.30	114.30	114.30	114.30	114.30

Table 5: Transition Paths after AIDS shock for all Aggregate Variables and Wages under Scenario 2 (all variables normalized to 100 at $t = 0$)

Period		0	1	2	3	4	5	10
Y	$\pi^1 = 0, \pi^2 = 0.129$	100	98.69	97.14	97.96	99.34	99.76	100
	$\pi^1 = \pi^2 = 0.07$	100	97.85	94.26	96.12	99.70	99.89	100
	$\pi^1 = 0.152, \pi^2 = 0$	100	96.81	90.41	93.50	100.35	100.13	100
L^1	$\pi^1 = 0, \pi^2 = 0.129$	100	100	100	100	100	100	100
	$\pi^1 = \pi^2 = 0.07$	100	96.50	89.75	93.00	100	100	100
	$\pi^1 = 0.152, \pi^2 = 0$	100	92.40	78.36	84.80	100	100	100
L^2	$\pi^1 = 0, \pi^2 = 0.129$	100	94.46	93.74	99.24	100	100	100
	$\pi^1 = \pi^2 = 0.07$	100	97.02	103.01	106.17	100	100	100
	$\pi^1 = 0.152, \pi^2 = 0$	100	100.06	114.37	114.30	100	100	100
K	$\pi^1 = 0, \pi^2 = 0.129$	100	100	96.16	94.85	98.17	99.33	100
	$\pi^1 = \pi^2 = 0.07$	100	100	94.17	93.60	99.16	99.70	100
	$\pi^1 = 0.152, \pi^2 = 0$	100	100	91.50	91.81	100.99	100.36	100
w_1	$\pi^1 = 0, \pi^2 = 0.129$	100	98.70	97.11	97.90	99.32	99.75	100
	$\pi^1 = \pi^2 = 0.07$	100	101.45	105.07	103.34	99.69	99.89	100
	$\pi^1 = 0.152, \pi^2 = 0$	100	104.86	115.51	110.29	100.36	100.13	100
w_2	$\pi^1 = 0, \pi^2 = 0.129$	100	104.43	103.60	98.73	99.35	99.76	100
	$\pi^1 = \pi^2 = 0.07$	100	100.85	91.59	90.63	99.70	99.89	100
	$\pi^1 = 0.152, \pi^2 = 0$	100	96.79	79.24	81.96	100.35	100.13	100
H^1	$\pi^1 = 0, \pi^2 = 0.129$	100	100	100	100	100	100	100
	$\pi^1 = \pi^2 = 0.07$	100	100	93.00	93.00	100	100	100
	$\pi^1 = 0.152, \pi^2 = 0$	100	100	84.80	84.80	100	100	100
H^2	$\pi^1 = 0, \pi^2 = 0.129$	100	100	99.24	99.24	100	100	100
	$\pi^1 = \pi^2 = 0.07$	100	100	106.17	106.17	100	100	100
	$\pi^1 = 0.152, \pi^2 = 0$	100	100	114.30	114.30	100	100	100

Table 6: Total Sum of Squares for Every Case under Scenarios 1 to 4 Relative to no AIDS Case

	Scenario 1	Scenario 2
Case	TSS	TSS
$\pi^1 = 0, \pi^2 = 0.129$	0.00131	0.00007
$\pi^1 = 0.035, \pi^2 = 0.10$	0.00235	0.00015
$\pi^1 = \pi^2 = 0.07$	0.00380	0.00027
$\pi^1 = 0.10, \pi^2 = 0.044$	0.00542	0.00041
$\pi^1 = 0.152, \pi^2 = 0$	0.00930	0.00075
	Scenario 3	Scenario 4
Case	TSS	TSS
$\pi^1 = 0, \pi^2 = 0.356$	0.0111	0.00065
$\pi^1 = 0.10, \pi^2 = 0.269$	0.0177	0.00123
$\pi^1 = \pi^2 = 0.20$	0.0306	0.00236
$\pi^1 = 0.295, \pi^2 = 0.10$	0.0463	0.00385
$\pi^1 = 0.41, \pi^2 = 0$	0.0788	0.00693

Table 7: Output Levels Relative to no AIDS Scenario (in %) for Scenario 1 with Different Ψ^i Values

$\Psi^1 = \Psi^2 = 0.4$							
Period	0	1	2	3	4	5	10
no AIDS	100	100	100	100	100	100	100
$\pi^1 = 0, \pi^2 = 0.129$	100	98.44	96.53	96.12	95.98	95.92	95.89
$\pi^1 = 0.035, \pi^2 = 0.10$	100	97.95	95.08	94.81	94.71	94.68	94.66
$\pi^1 = \pi^2 = 0.07$	100	97.45	93.56	93.43	93.38	93.36	93.36
$\pi^1 = 0.10, \pi^2 = 0.044$	100	97.00	92.17	92.17	92.17	92.17	92.17
$\pi^1 = 0.152, \pi^2 = 0$	100	96.18	89.56	89.78	89.86	89.89	89.90
Baseline: $\Psi^1 = \Psi^2 = 0.5$							
Period	0	1	2	3	4	5	10
no AIDS	100	100	100	100	100	100	100
$\pi^1 = 0, \pi^2 = 0.129$	100	98.69	97.14	96.67	96.50	96.44	96.40
$\pi^1 = 0.035, \pi^2 = 0.10$	100	98.27	95.74	95.40	95.28	95.24	95.21
$\pi^1 = \pi^2 = 0.07$	100	97.85	94.26	94.06	93.99	93.96	93.95
$\pi^1 = 0.10, \pi^2 = 0.044$	100	97.49	92.92	92.84	92.80	92.79	92.78
$\pi^1 = 0.152, \pi^2 = 0$	100	96.81	90.41	90.51	90.55	90.57	90.57
$\Psi^1 = 0.54$ and $\Psi^2 = 0.4$							
Period	0	1	2	3	4	5	10
no AIDS	100	100	100	100	100	100	100
$\pi^1 = 0, \pi^2 = 0.129$	100	98.44	96.53	96.12	95.98	95.92	95.89
$\pi^1 = 0.035, \pi^2 = 0.10$	100	98.14	95.37	95.06	94.95	94.91	94.89
$\pi^1 = \pi^2 = 0.07$	100	97.84	94.12	93.92	93.84	93.82	93.81
$\pi^1 = 0.10, \pi^2 = 0.044$	100	97.57	92.97	92.86	92.82	92.81	92.80
$\pi^1 = 0.152, \pi^2 = 0$	100	97.06	90.74	90.80	90.83	90.84	90.84
$\Psi^1 = 0.54$ and $\Psi^2 = 0.5$							
Period	0	1	2	3	4	5	10
no AIDS	100	100	100	100	100	100	100
$\pi^1 = 0, \pi^2 = 0.129$	100	98.69	97.14	96.67	96.50	96.44	96.40
$\pi^1 = 0.035, \pi^2 = 0.10$	100	98.33	95.82	95.48	95.35	95.30	95.28
$\pi^1 = \pi^2 = 0.07$	100	97.97	94.42	94.20	94.12	94.09	94.07
$\pi^1 = 0.10, \pi^2 = 0.044$	100	97.65	93.15	93.03	92.99	92.98	92.97
$\pi^1 = 0.152, \pi^2 = 0$	100	97.06	90.74	90.80	90.83	90.83	90.84

Table 8: Output Levels Relative to no AIDS Scenario (in %) for Scenario 2 with Different Ψ^i Values

$\Psi^1 = \Psi^2 = 0.4$							
Period	0	1	2	3	4	5	10
no AIDS	100	100	100	100	100	100	100
$\pi^1 = 0, \pi^2 = 0.129$	100	98.44	96.53	97.65	99.44	99.80	100
$\pi^1 = 0.035, \pi^2 = 0.10$	100	97.95	95.08	96.80	99.60	99.85	100
$\pi^1 = \pi^2 = 0.07$	100	97.45	93.56	95.88	99.81	99.93	100
$\pi^1 = 0.10, \pi^2 = 0.044$	100	97.00	92.17	95.02	100.02	100.01	100
$\pi^1 = 0.152, \pi^2 = 0$	100	96.18	89.56	93.35	100.47	100.17	100
Baseline: $\Psi^1 = \Psi^2 = 0.5$							
Period	0	1	2	3	4	5	10
no AIDS	100	100	100	100	100	100	100
$\pi^1 = 0, \pi^2 = 0.129$	100	98.69	97.14	97.96	99.34	99.76	99.99
$\pi^1 = 0.035, \pi^2 = 0.10$	100	98.27	95.74	97.08	99.50	99.82	100
$\pi^1 = \pi^2 = 0.07$	100	97.85	94.26	96.12	99.70	99.89	100
$\pi^1 = 0.10, \pi^2 = 0.044$	100	97.49	92.92	95.23	99.91	99.97	100
$\pi^1 = 0.152, \pi^2 = 0$	100	96.81	90.41	93.50	100.35	100.13	100
$\Psi^1 = 0.54$ and $\Psi^2 = 0.4$							
Period	0	1	2	3	4	5	10
no AIDS	100	100	100	100	100	100	100
$\pi^1 = 0, \pi^2 = 0.129$	100	98.44	96.53	97.65	99.44	99.80	100
$\pi^1 = 0.035, \pi^2 = 0.10$	100	98.14	95.37	96.86	99.55	99.84	100
$\pi^1 = \pi^2 = 0.07$	100	97.84	94.12	96.00	99.71	99.90	100
$\pi^1 = 0.10, \pi^2 = 0.044$	100	97.57	92.97	95.18	99.90	99.96	100
$\pi^1 = 0.152, \pi^2 = 0$	100	97.06	90.74	93.55	100.31	100.11	100
$\Psi^1 = 0.54$ and $\Psi^2 = 0.5$							
Period	0	1	2	3	4	5	10
no AIDS	100	100	100	100	100	100	100
$\pi^1 = 0, \pi^2 = 0.129$	100	98.69	97.14	97.96	99.34	99.76	100
$\pi^1 = 0.035, \pi^2 = 0.10$	100	98.33	95.82	97.10	99.48	99.81	100
$\pi^1 = \pi^2 = 0.07$	100	97.97	94.42	96.16	99.68	99.88	100
$\pi^1 = 0.10, \pi^2 = 0.044$	100	97.65	93.15	95.28	99.88	99.96	100
$\pi^1 = 0.152, \pi^2 = 0$	100	97.06	90.74	93.55	100.31	100.11	100

Table 9: Output Levels Relative to no AIDS Scenario (in %) for Scenario 5 with Different Ψ^i Values

Period	0	1	2	3	4	5	10
no AIDS	100	100	100	100	100	100	100
$\Psi^1 = \Psi^2 = 0.4$	100	97.74	91.33	93.29	98.99	99.63	100
Baseline: $\Psi^1 = \Psi^2 = 0.5$	100	98.10	92.33	94.24	98.80	99.56	100
$\Psi^1 = 0.54$ and $\Psi^2 = 0.4$	100	98.19	91.79	93.37	98.91	99.60	100
$\Psi^1 = 0.54$ and $\Psi^2 = 0.5$	100	98.23	92.46	94.26	98.78	99.55	100

Table 10: Output Levels Relative to no AIDS Scenario (in %) for Scenario 1 with Different Δ Values

$\Delta = 0.05$							
Period	0	1	2	3	4	5	10
no AIDS	100	100	100	100	100	100	100
$\pi^1 = 0, \pi^2 = 0.129$	100	98.45	96.60	96.16	96.00	95.94	95.91
$\pi^1 = 0.035, \pi^2 = 0.10$	100	98.10	95.31	94.92	94.78	94.72	94.69
$\pi^1 = \pi^2 = 0.07$	100	97.74	93.94	93.60	93.48	93.44	93.41
$\pi^1 = 0.10, \pi^2 = 0.044$	100	97.43	92.68	92.40	92.30	92.26	92.24
$\pi^1 = 0.152, \pi^2 = 0$	100	96.83	90.31	90.12	90.05	90.02	90.00
$\Delta = 0.1$							
Period	0	1	2	3	4	5	10
no AIDS	100	100	100	100	100	100	100
$\pi^1 = 0, \pi^2 = 0.129$	100	98.57	96.89	96.43	96.26	96.20	96.16
$\pi^1 = 0.035, \pi^2 = 0.10$	100	98.19	95.54	95.17	95.04	94.99	94.96
$\pi^1 = \pi^2 = 0.07$	100	97.80	94.11	93.84	93.74	93.71	93.69
$\pi^1 = 0.10, \pi^2 = 0.044$	100	97.46	92.81	92.63	92.56	92.54	92.52
$\pi^1 = 0.152, \pi^2 = 0$	100	96.82	90.36	90.32	90.31	90.30	90.30
Baseline: $\Delta = 0.15$							
Period	0	1	2	3	4	5	10
no AIDS	100	100	100	100	100	100	100
$\pi^1 = 0, \pi^2 = 0.129$	100	98.69	97.14	96.67	96.50	96.44	96.40
$\pi^1 = 0.035, \pi^2 = 0.10$	100	98.27	95.74	95.40	95.28	95.24	95.21
$\pi^1 = \pi^2 = 0.07$	100	97.85	94.26	94.06	93.99	93.96	93.95
$\pi^1 = 0.10, \pi^2 = 0.044$	100	97.49	92.92	92.84	92.80	92.79	92.78
$\pi^1 = 0.152, \pi^2 = 0$	100	96.81	90.41	90.51	90.55	90.57	90.57
$\Delta = 0.2$							
Period	0	1	2	3	4	5	10
no AIDS	100	100	100	100	100	100	100
$\pi^1 = 0, \pi^2 = 0.129$	100	98.78	97.38	96.90	96.73	96.67	96.63
$\pi^1 = 0.035, \pi^2 = 0.10$	100	98.34	95.93	95.62	95.51	95.47	95.45
$\pi^1 = \pi^2 = 0.07$	100	97.90	94.40	94.27	94.22	94.20	94.19
$\pi^1 = 0.10, \pi^2 = 0.044$	100	97.51	93.02	92.03	93.03	93.03	93.03
$\pi^1 = 0.152, \pi^2 = 0$	100	96.80	90.45	90.69	90.77	90.81	90.82
$\Delta = 0.3$							
Period	0	1	2	3	4	5	10
no AIDS	100	100	100	100	100	100	100
$\pi^1 = 0, \pi^2 = 0.129$	100	98.93	97.78	97.32	97.15	97.09	97.06
$\pi^1 = 0.035, \pi^2 = 0.10$	100	98.45	96.25	96.02	95.93	95.90	95.88
$\pi^1 = \pi^2 = 0.07$	100	97.97	94.64	94.63	94.63	94.63	94.63
$\pi^1 = 0.10, \pi^2 = 0.044$	100	97.55	93.20	93.37	93.44	93.46	93.47
$\pi^1 = 0.152, \pi^2 = 0$	100	96.78	90.51	90.99	91.17	91.23	91.27

Table 11: Output Levels Relative to no AIDS Scenario (in %) for Scenario 2 with Different Δ Values

$\Delta = 0.05$							
Period	0	1	2	3	4	5	10
no AIDS	100	100	100	100	100	100	100
$\pi^1 = 0, \pi^2 = 0.129$	100	98.44	96.60	97.68	99.39	99.78	100
$\pi^1 = 0.035, \pi^2 = 0.10$	100	98.10	95.31	96.76	99.43	99.79	100
$\pi^1 = \pi^2 = 0.07$	100	97.74	93.94	95.77	99.51	99.82	100
$\pi^1 = 0.10, \pi^2 = 0.044$	100	97.43	92.68	94.84	99.63	99.86	100
$\pi^1 = 0.152, \pi^2 = 0$	100	96.83	90.31	93.06	99.90	99.96	100
$\Delta = 0.1$							
Period	0	1	2	3	4	5	10
no AIDS	100	100	100	100	100	100	100
$\pi^1 = 0, \pi^2 = 0.129$	100	98.58	96.89	97.82	99.36	99.77	100
$\pi^1 = 0.035, \pi^2 = 0.10$	100	98.19	95.54	96.92	99.46	99.80	100
$\pi^1 = \pi^2 = 0.07$	100	97.80	94.11	95.95	99.61	99.86	100
$\pi^1 = 0.10, \pi^2 = 0.044$	100	97.46	92.81	95.04	99.77	99.92	100
$\pi^1 = 0.152, \pi^2 = 0$	100	96.82	90.36	93.29	100.14	100.05	100
Baseline: $\Delta = 0.15$							
Period	0	1	2	3	4	5	10
no AIDS	100	100	100	100	100	100	100
$\pi^1 = 0, \pi^2 = 0.129$	100	98.69	97.14	97.96	99.34	99.76	99.99
$\pi^1 = 0.035, \pi^2 = 0.10$	100	98.27	95.74	97.08	99.50	99.82	100
$\pi^1 = \pi^2 = 0.07$	100	97.85	94.26	96.12	99.70	99.89	100
$\pi^1 = 0.10, \pi^2 = 0.044$	100	97.49	92.92	95.23	99.91	99.97	100
$\pi^1 = 0.152, \pi^2 = 0$	100	96.81	90.41	93.50	100.35	100.13	100
$\Delta = 0.2$							
Period	0	1	2	3	4	5	10
no AIDS	100	100	100	100	100	100	100
$\pi^1 = 0, \pi^2 = 0.129$	100	98.78	97.38	98.10	99.34	99.76	100
$\pi^1 = 0.035, \pi^2 = 0.10$	100	98.34	95.93	97.24	99.54	99.83	100
$\pi^1 = \pi^2 = 0.07$	100	97.90	94.40	96.29	99.80	99.93	100
$\pi^1 = 0.10, \pi^2 = 0.044$	100	97.51	93.02	95.41	100.05	100.02	100
$\pi^1 = 0.152, \pi^2 = 0$	100	96.80	90.45	93.68	100.55	100.20	100
$\Delta = 0.3$							
Period	0	1	2	3	4	5	10
no AIDS	100	100	100	100	100	100	100
$\pi^1 = 0, \pi^2 = 0.129$	100	98.93	97.78	98.37	99.36	99.77	100
$\pi^1 = 0.035, \pi^2 = 0.10$	100	98.45	96.25	97.53	99.65	99.87	100
$\pi^1 = \pi^2 = 0.07$	100	97.97	94.64	96.60	99.97	99.99	100
$\pi^1 = 0.10, \pi^2 = 0.044$	100	97.55	93.20	95.72	100.29	100.11	100
$\pi^1 = 0.152, \pi^2 = 0$	100	96.78	90.51	94.02	100.91	100.33	100

Table 12: Output Levels Relative to no AIDS Scenario (in %) for Scenario 5 with Different Δ Values

Period	0	1	2	3	4	5	10
no AIDS	100	100	100	100	100	100	100
$\Delta = 0.05$	100	98.08	91.62	93.25	98.67	99.51	100
$\Delta = 0.1$	100	98.09	92.00	93.76	98.72	99.53	100
Baseline: $\Delta = 0.15$	100	98.10	92.33	94.24	98.80	99.56	100
$\Delta = 0.2$	100	98.12	92.60	94.68	98.89	99.59	100
$\Delta = 0.3$	100	98.13	93.05	95.47	99.09	99.67	100

Table 13: Output Levels Relative to no AIDS Scenario (in %) for Scenario 1 with Different $B^{i,j}$ Values

Baseline: $B^{1,h} = B^{1,s} = B^{2,h} = B^{2,s} = 1$							
Period	0	1	2	3	4	5	10
no AIDS	100	100	100	100	100	100	100
$\pi^1 = 0, \pi^2 = 0.129$	100	98.69	97.14	96.67	96.50	96.44	96.40
$\pi^1 = 0.035, \pi^2 = 0.10$	100	98.27	95.74	95.40	95.28	95.24	95.21
$\pi^1 = \pi^2 = 0.07$	100	97.85	94.26	94.06	93.99	93.96	93.95
$\pi^1 = 0.10, \pi^2 = 0.044$	100	97.49	92.92	92.84	92.80	92.79	92.78
$\pi^1 = 0.152, \pi^2 = 0$	100	96.81	90.41	90.51	90.55	90.57	90.57
$B^{1,h} = 1$ and $B^{1,s} = B^{2,h} = B^{2,s} = 0.90$							
Period	0	1	2	3	4	5	10
no AIDS	100	100	100	100	100	100	100
$\pi^1 = 0, \pi^2 = 0.129$	100	98.69	97.15	96.67	96.50	96.44	96.40
$\pi^1 = 0.035, \pi^2 = 0.10$	100	98.27	95.74	95.40	95.28	95.24	95.21
$\pi^1 = \pi^2 = 0.07$	100	97.86	94.26	94.06	93.99	93.96	93.95
$\pi^1 = 0.10, \pi^2 = 0.044$	100	97.49	92.92	92.84	92.80	92.79	92.79
$\pi^1 = 0.152, \pi^2 = 0$	100	96.81	90.40	90.51	90.55	90.56	90.57
$B^{1,h} = 1$ and $B^{1,s} = B^{2,h} = B^{2,s} = 0.75$							
Period	0	1	2	3	4	5	10
no AIDS	100	100	100	100	100	100	100
$\pi^1 = 0, \pi^2 = 0.129$	100	98.69	97.15	96.67	96.50	96.44	96.40
$\pi^1 = 0.035, \pi^2 = 0.10$	100	98.28	95.74	95.40	95.28	95.24	95.21
$\pi^1 = \pi^2 = 0.07$	100	97.86	94.26	94.06	93.99	93.96	93.94
$\pi^1 = 0.10, \pi^2 = 0.044$	100	97.49	92.92	92.83	92.80	92.79	92.78
$\pi^1 = 0.152, \pi^2 = 0$	100	96.81	90.40	90.51	90.55	90.56	90.57
$B^{1,h} = B^{2,h} = 1$ and $B^{1,s} = B^{2,s} = 0.50$							
Period	0	1	2	3	4	5	10
no AIDS	100	100	100	100	100	100	100
$\pi^1 = 0, \pi^2 = 0.129$	100	98.69	95.73	95.45	95.35	95.31	95.29
$\pi^1 = 0.035, \pi^2 = 0.10$	100	98.27	94.34	94.17	94.11	94.09	94.08
$\pi^1 = \pi^2 = 0.07$	100	97.85	92.87	92.83	92.81	92.80	92.80
$\pi^1 = 0.10, \pi^2 = 0.044$	100	97.49	91.55	91.60	91.62	91.63	91.63
$\pi^1 = 0.152, \pi^2 = 0$	100	96.81	89.06	89.28	89.36	89.39	89.41
$B^{1,h} = 1, B^{2,h} = 0.90, B^{1,s} = 0.50, \text{ and } B^{2,s} = 0.45$							
Period	0	1	2	3	4	5	10
no AIDS	100	100	100	100	100	100	100
$\pi^1 = 0, \pi^2 = 0.129$	100	98.69	95.73	95.45	95.35	95.32	95.29
$\pi^1 = 0.035, \pi^2 = 0.10$	100	98.27	94.38	94.21	94.15	94.12	94.11
$\pi^1 = \pi^2 = 0.07$	100	97.86	92.95	92.90	92.88	92.87	92.86
$\pi^1 = 0.10, \pi^2 = 0.044$	100	97.49	91.66	91.70	91.72	91.72	91.72
$\pi^1 = 0.152, \pi^2 = 0$	100	96.81	89.21	89.42	89.49	89.52	89.54

Table 14: Output Levels Relative to no AIDS Scenario (in %) for Scenario 2 with Different $B^{i,j}$ Values

Baseline: $B^{1,h} = B^{1,s} = B^{2,h} = B^{2,s} = 1$							
Period	0	1	2	3	4	5	10
no AIDS	100	100	100	100	100	100	100
$\pi^1 = 0, \pi^2 = 0.129$	100	98.69	97.14	97.96	99.34	99.76	99.99
$\pi^1 = 0.035, \pi^2 = 0.10$	100	98.27	95.74	97.08	99.50	99.82	100
$\pi^1 = \pi^2 = 0.07$	100	97.85	94.26	96.12	99.70	99.89	100
$\pi^1 = 0.10, \pi^2 = 0.044$	100	97.49	92.92	95.23	99.91	99.97	100
$\pi^1 = 0.152, \pi^2 = 0$	100	96.81	90.41	93.50	100.35	100.13	100
$B^{1,h} = 1$ and $B^{1,s} = B^{2,h} = B^{2,s} = 0.90$							
Period	0	1	2	3	4	5	10
no AIDS	100	100	100	100	100	100	100
$\pi^1 = 0, \pi^2 = 0.129$	100	98.69	97.15	97.96	99.34	99.76	100
$\pi^1 = 0.035, \pi^2 = 0.10$	100	98.27	95.74	97.08	99.50	99.82	100
$\pi^1 = \pi^2 = 0.07$	100	97.86	94.26	96.12	99.70	99.89	100
$\pi^1 = 0.10, \pi^2 = 0.044$	100	97.49	92.92	95.23	99.91	99.97	100
$\pi^1 = 0.152, \pi^2 = 0$	100	96.81	90.40	93.49	100.35	100.13	100
$B^{1,h} = 1$ and $B^{1,s} = B^{2,h} = B^{2,s} = 0.75$							
Period	0	1	2	3	4	5	10
no AIDS	100	100	100	100	100	100	100
$\pi^1 = 0, \pi^2 = 0.129$	100	98.69	97.15	97.96	99.34	99.76	100
$\pi^1 = 0.035, \pi^2 = 0.10$	100	98.28	95.74	97.08	99.50	99.82	100
$\pi^1 = \pi^2 = 0.07$	100	97.86	94.26	96.12	99.70	99.89	100
$\pi^1 = 0.10, \pi^2 = 0.044$	100	97.49	92.92	95.23	99.91	99.97	100
$\pi^1 = 0.152, \pi^2 = 0$	100	96.81	90.40	93.49	100.35	100.13	100
$B^{1,h} = B^{2,h} = 1$ and $B^{1,s} = B^{2,s} = 0.50$							
Period	0	1	2	3	4	5	10
no AIDS	100	100	100	100	100	100	100
$\pi^1 = 0, \pi^2 = 0.129$	100	98.69	95.73	96.72	99.65	99.87	100
$\pi^1 = 0.035, \pi^2 = 0.10$	100	98.27	94.34	95.83	99.76	99.91	100
$\pi^1 = \pi^2 = 0.07$	100	97.85	92.87	94.86	99.93	99.97	100
$\pi^1 = 0.10, \pi^2 = 0.044$	100	97.49	91.55	93.97	100.11	100.04	100
$\pi^1 = 0.152, \pi^2 = 0$	100	96.81	89.06	92.22	100.49	100.18	100
$B^{1,h} = 1, B^{2,h} = 0.90, B^{1,s} = 0.50, \text{ and } B^{2,s} = 0.45$							
Period	0	1	2	3	4	5	10
no AIDS	100	100	100	100	100	100	100
$\pi^1 = 0, \pi^2 = 0.129$	100	98.69	95.73	96.72	99.65	99.87	100
$\pi^1 = 0.035, \pi^2 = 0.10$	100	98.27	94.38	95.86	99.76	99.91	100
$\pi^1 = \pi^2 = 0.07$	100	97.86	92.95	94.93	99.92	99.97	100
$\pi^1 = 0.10, \pi^2 = 0.044$	100	97.49	91.66	94.06	100.09	100.03	100
$\pi^1 = 0.152, \pi^2 = 0$	100	96.81	89.21	92.36	100.47	100.17	100

Table 15: Output Levels Relative to no AIDS Scenario (in %) for Scenario 5 with Different $B^{i,j}$ Values

Period	0	1	2	3	4	5	10
no AIDS	100	100	100	100	100	100	100
Baseline: $B^{1,h} = B^{1,s} = B^{2,h} = B^{2,s} = 1$	100	98.10	92.33	94.24	98.80	99.56	100
$B^{1,h} = 1$ and $B^{1,s} = B^{2,h} = B^{2,s} = 0.9$	100	98.11	92.33	94.24	98.80	99.56	100
$B^{1,h} = 1$ and $B^{1,s} = B^{2,h} = B^{2,s} = 0.75$	100	98.11	92.33	94.23	98.79	99.56	100
$B^{1,h} = B^{2,h} = 1$ and $B^{1,s} = B^{2,s} = 0.5$	100	98.10	91.33	90.43	99.43	99.79	100
$B^{1,h} = 1$, $B^{2,h} = 0.9$, $B^{1,s} = 0.5$, and $B^{2,s} = 0.45$	100	98.11	91.42	90.49	99.42	99.79	100

Table 16: Output Levels Relative to no AIDS Scenario (in %) for Scenario 1 with Different μ Values

$\mu = 0.005$							
Period	0	1	2	3	4	5	10
no AIDS	100	100	100	100	100	100	100
$\pi^1 = 0, \pi^2 = 0.129$	100	98.69	97.16	96.68	96.51	96.45	96.42
$\pi^1 = 0.035, \pi^2 = 0.10$	100	98.29	95.74	95.41	95.28	95.24	95.21
$\pi^1 = \pi^2 = 0.07$	100	97.86	94.25	94.05	93.98	93.95	93.93
$\pi^1 = 0.10, \pi^2 = 0.044$	100	97.49	92.90	92.81	92.78	92.77	92.76
$\pi^1 = 0.152, \pi^2 = 0$	100	96.81	90.37	90.47	90.51	90.52	90.53
Baseline: $\mu = 0.01$							
Period	0	1	2	3	4	5	10
no AIDS	100	100	100	100	100	100	100
$\pi^1 = 0, \pi^2 = 0.129$	100	98.69	97.14	96.67	96.50	96.44	96.40
$\pi^1 = 0.035, \pi^2 = 0.10$	100	98.27	95.74	95.40	95.28	95.24	95.21
$\pi^1 = \pi^2 = 0.07$	100	97.85	94.26	94.06	93.99	93.96	93.95
$\pi^1 = 0.10, \pi^2 = 0.044$	100	97.49	92.92	92.84	92.80	92.79	92.78
$\pi^1 = 0.152, \pi^2 = 0$	100	96.81	90.41	90.51	90.55	90.57	90.57
$\mu = 0.1$							
Period	0	1	2	3	4	5	10
no AIDS	100	100	100	100	100	100	100
$\pi^1 = 0, \pi^2 = 0.129$	100	98.58	96.95	96.46	96.29	96.23	96.20
$\pi^1 = 0.035, \pi^2 = 0.10$	100	98.21	95.74	95.40	95.29	95.24	95.22
$\pi^1 = \pi^2 = 0.07$	100	97.83	94.47	94.28	94.21	94.19	94.17
$\pi^1 = 0.10, \pi^2 = 0.044$	100	97.50	93.31	93.24	93.22	93.21	93.20
$\pi^1 = 0.152, \pi^2 = 0$	100	96.89	91.11	91.25	91.30	91.32	91.32
$\mu = 0.25$							
Period	0	1	2	3	4	5	10
no AIDS	100	100	100	100	100	100	100
$\pi^1 = 0, \pi^2 = 0.129$	100	98.40	96.63	96.13	95.97	95.91	95.89
$\pi^1 = 0.035, \pi^2 = 0.10$	100	98.10	95.75	95.42	95.31	95.27	95.26
$\pi^1 = \pi^2 = 0.07$	100	97.80	94.82	94.66	94.60	94.59	94.58
$\pi^1 = 0.10, \pi^2 = 0.044$	100	97.53	93.97	93.94	93.94	93.93	93.93
$\pi^1 = 0.152, \pi^2 = 0$	100	97.03	92.33	92.53	92.60	92.62	92.63
$\mu = 0.5$							
Period	0	1	2	3	4	5	10
no AIDS	100	100	100	100	100	100	100
$\pi^1 = 0, \pi^2 = 0.129$	100	98.10	96.12	95.63	95.49	95.44	95.43
$\pi^1 = 0.035, \pi^2 = 0.10$	100	97.91	95.79	95.50	95.41	95.39	95.38
$\pi^1 = \pi^2 = 0.07$	100	97.73	95.44	95.34	95.31	95.30	95.30
$\pi^1 = 0.10, \pi^2 = 0.044$	100	97.58	95.12	95.17	95.19	95.19	95.19
$\pi^1 = 0.152, \pi^2 = 0$	100	97.27	94.43	94.74	94.83	94.86	94.87

Table 17: Output Levels Relative to no AIDS Scenario (in %) for Scenario 2 with Different μ Values

$\mu = 0.005$							
Period	0	1	2	3	4	5	10
no AIDS	100	100	100	100	100	100	100
$\pi^1 = 0, \pi^2 = 0.129$	100	98.69	97.16	97.97	99.34	99.76	100
$\pi^1 = 0.035, \pi^2 = 0.10$	100	98.28	95.74	97.08	99.50	99.82	100
$\pi^1 = \pi^2 = 0.07$	100	97.86	94.25	96.11	99.70	99.89	100
$\pi^1 = 0.10, \pi^2 = 0.044$	100	97.49	92.90	95.21	99.91	99.97	100
$\pi^1 = 0.152, \pi^2 = 0$	100	96.81	90.37	93.46	100.35	100.13	100
Baseline: $\mu = 0.01$							
Period	0	1	2	3	4	5	10
no AIDS	100	100	100	100	100	100	100
$\pi^1 = 0, \pi^2 = 0.129$	100	98.69	97.14	97.96	99.34	99.76	99.99
$\pi^1 = 0.035, \pi^2 = 0.10$	100	98.27	95.74	97.08	99.50	99.82	100
$\pi^1 = \pi^2 = 0.07$	100	97.85	94.26	96.12	99.70	99.89	100
$\pi^1 = 0.10, \pi^2 = 0.044$	100	97.49	92.92	95.23	99.91	99.97	100
$\pi^1 = 0.152, \pi^2 = 0$	100	96.81	90.41	93.50	100.35	100.13	100
$\mu = 0.1$							
Period	0	1	2	3	4	5	10
no AIDS	100	100	100	100	100	100	100
$\pi^1 = 0, \pi^2 = 0.129$	100	98.58	96.95	97.85	99.33	99.77	100
$\pi^1 = 0.035, \pi^2 = 0.10$	100	98.21	95.74	97.15	99.50	99.83	100
$\pi^1 = \pi^2 = 0.07$	100	97.83	94.47	96.37	99.72	99.90	100
$\pi^1 = 0.10, \pi^2 = 0.044$	100	97.50	93.31	95.63	99.94	99.98	100
$\pi^1 = 0.152, \pi^2 = 0$	100	96.89	91.11	94.16	100.39	100.14	100
$\mu = 0.25$							
Period	0	1	2	3	4	5	10
no AIDS	100	100	100	100	100	100	100
$\pi^1 = 0, \pi^2 = 0.129$	100	98.40	96.63	97.70	99.33	99.78	100
$\pi^1 = 0.035, \pi^2 = 0.10$	100	98.10	95.75	97.28	99.53	99.85	100
$\pi^1 = \pi^2 = 0.07$	100	97.80	94.82	96.80	99.76	99.92	100
$\pi^1 = 0.10, \pi^2 = 0.044$	100	97.53	93.97	96.32	100	100	100
$\pi^1 = 0.152, \pi^2 = 0$	100	97.03	92.33	95.31	100.46	100.15	100
$\mu = 0.5$							
Period	0	1	2	3	4	5	10
no AIDS	100	100	100	100	100	100	100
$\pi^1 = 0, \pi^2 = 0.129$	100	98.10	96.12	97.50	99.37	99.82	100
$\pi^1 = 0.035, \pi^2 = 0.10$	100	97.91	95.79	97.56	99.60	99.89	100
$\pi^1 = \pi^2 = 0.07$	100	97.73	95.44	97.57	99.86	99.96	100
$\pi^1 = 0.10, \pi^2 = 0.044$	100	97.58	95.12	97.52	100.10	100.03	100
$\pi^1 = 0.152, \pi^2 = 0$	100	97.27	94.43	97.29	100.57	100.16	100

Table 18: Output Levels Relative to no AIDS Scenario (in %) for Scenario 5 with Different μ Values

Period	0	1	2	3	4	5	10
no AIDS	100	100	100	100	100	100	100
$\mu = 0.005$	100	98.10	92.32	94.24	98.80	99.56	100
Baseline: $\mu = 0.01$	100	98.10	92.33	94.24	98.80	99.56	100
$\mu = 0.1$	100	98.13	92.38	94.22	98.79	99.57	100
$\mu = 0.25$	100	98.16	92.46	94.23	98.80	99.61	100
$\mu = 0.5$	100	98.23	92.59	94.35	98.89	99.68	100

Table 19: Output Levels Relative to no AIDS Scenario (in %) for Scenario 1 with Different ϕ Values

$\phi = -0.01$							
Period	0	1	2	3	4	5	10
no AIDS	100	100	100	100	100	100	100
$\pi^1 = 0, \pi^2 = 0.129$	100	98.69	97.18	96.73	96.58	96.52	96.49
$\pi^1 = 0.035, \pi^2 = 0.10$	100	98.26	95.74	95.42	95.31	95.27	95.24
$\pi^1 = \pi^2 = 0.07$	100	97.83	94.22	94.03	93.96	93.94	93.92
$\pi^1 = 0.10, \pi^2 = 0.044$	100	97.45	92.85	92.76	92.73	92.72	92.72
$\pi^1 = 0.152, \pi^2 = 0$	100	96.76	90.28	90.38	90.41	90.42	90.43
Baseline: $\phi = -0.025$							
Period	0	1	2	3	4	5	10
no AIDS	100	100	100	100	100	100	100
$\pi^1 = 0, \pi^2 = 0.129$	100	98.69	97.14	96.67	96.50	96.44	96.40
$\pi^1 = 0.035, \pi^2 = 0.10$	100	98.27	95.74	95.40	95.28	95.24	95.21
$\pi^1 = \pi^2 = 0.07$	100	97.85	94.26	94.06	93.99	93.96	93.95
$\pi^1 = 0.10, \pi^2 = 0.044$	100	97.49	92.92	92.84	92.80	92.79	92.78
$\pi^1 = 0.152, \pi^2 = 0$	100	96.81	90.41	90.51	90.55	90.57	90.57
$\phi = -0.04$							
Period	0	1	2	3	4	5	10
no AIDS	100	100	100	100	100	100	100
$\pi^1 = 0, \pi^2 = 0.129$	100	98.69	97.11	96.61	96.42	96.35	96.31
$\pi^1 = 0.035, \pi^2 = 0.10$	100	98.28	95.75	95.39	95.26	95.21	95.18
$\pi^1 = \pi^2 = 0.07$	100	97.88	94.31	94.10	94.02	93.99	93.97
$\pi^1 = 0.10, \pi^2 = 0.044$	100	97.52	93.00	92.91	92.88	92.87	92.86
$\pi^1 = 0.152, \pi^2 = 0$	100	96.86	90.54	90.66	90.70	90.72	90.73
$\phi = -0.1$							
Period	0	1	2	3	4	5	10
no AIDS	100	100	100	100	100	100	100
$\pi^1 = 0, \pi^2 = 0.129$	100	98.69	96.94	96.31	96.05	95.93	95.85
$\pi^1 = 0.035, \pi^2 = 0.10$	100	98.33	95.76	95.32	95.13	95.05	94.99
$\pi^1 = \pi^2 = 0.07$	100	97.98	94.50	94.24	94.14	94.09	94.06
$\pi^1 = 0.10, \pi^2 = 0.044$	100	97.66	93.34	93.25	93.21	93.19	91.18
$\pi^1 = 0.152, \pi^2 = 0$	100	97.08	91.12	91.30	91.38	91.41	91.43

Table 20: Output Levels Relative to no AIDS Scenario (in %) for Scenario 2 with Different ϕ Values

$\phi = -0.01$							
Period	0	1	2	3	4	5	10
no AIDS	100	100	100	100	100	100	100
$\pi^1 = 0, \pi^2 = 0.129$	100	98.69	97.18	98.02	99.39	99.78	100
$\pi^1 = 0.035, \pi^2 = 0.10$	100	98.26	95.74	97.11	99.53	99.83	100
$\pi^1 = \pi^2 = 0.07$	100	97.83	94.22	96.11	99.72	99.90	100
$\pi^1 = 0.10, \pi^2 = 0.044$	100	97.45	92.85	95.19	99.92	99.97	100
$\pi^1 = 0.152, \pi^2 = 0$	100	96.76	90.28	93.40	100.33	100.12	100
Baseline: $\phi = -0.025$							
Period	0	1	2	3	4	5	10
no AIDS	100	100	100	100	100	100	100
$\pi^1 = 0, \pi^2 = 0.129$	100	98.69	97.14	97.96	99.34	99.76	99.99
$\pi^1 = 0.035, \pi^2 = 0.10$	100	98.27	95.74	97.08	99.50	99.82	100
$\pi^1 = \pi^2 = 0.07$	100	97.85	94.26	96.12	99.70	99.89	100
$\pi^1 = 0.10, \pi^2 = 0.044$	100	97.49	92.92	95.23	99.91	99.97	100
$\pi^1 = 0.152, \pi^2 = 0$	100	96.81	90.41	93.50	100.35	100.13	100
$\phi = -0.04$							
Period	0	1	2	3	4	5	10
no AIDS	100	100	100	100	100	100	100
$\pi^1 = 0, \pi^2 = 0.129$	100	98.69	97.11	97.90	99.30	99.74	100
$\pi^1 = 0.035, \pi^2 = 0.10$	100	98.28	95.75	97.06	99.47	99.80	100
$\pi^1 = \pi^2 = 0.07$	100	97.88	94.31	96.14	99.69	99.88	100
$\pi^1 = 0.10, \pi^2 = 0.044$	100	97.52	93.00	95.28	99.91	99.97	100
$\pi^1 = 0.152, \pi^2 = 0$	100	96.86	90.54	93.60	100.38	100.14	100
$\phi = -0.1$							
Period	0	1	2	3	4	5	10
no AIDS	100	100	100	100	100	100	100
$\pi^1 = 0, \pi^2 = 0.129$	100	98.69	96.94	97.60	99.08	99.61	100
$\pi^1 = 0.035, \pi^2 = 0.10$	100	98.33	95.73	96.93	99.31	99.71	100
$\pi^1 = \pi^2 = 0.07$	100	97.98	94.50	96.19	99.61	99.83	100
$\pi^1 = 0.10, \pi^2 = 0.044$	100	97.66	93.34	95.48	99.90	99.96	100
$\pi^1 = 0.152, \pi^2 = 0$	100	97.08	91.12	94.06	100.50	100.21	100

Table 21: Output Levels Relative to no AIDS Scenario (in %) for Scenario 5 with Different ϕ Values

Period	0	1	2	3	4	5	10
no AIDS	100	100	100	100	100	100	100
$\phi = -0.01$	100	98.08	92.27	94.29	98.86	99.60	100
Baseline: $\phi = -0.025$	100	98.10	92.33	94.24	98.80	99.56	100
$\phi = -0.04$	100	98.13	92.38	94.18	98.73	99.52	100
$\phi = -0.1$	100	98.25	92.62	93.92	98.41	99.32	99.99

Figure 1: Skill Premium under Every Case for Scenario 1 before and after the AIDS Epidemic

Figure 2: Skill Premium under Every Case for Scenario 2 before and after the AIDS Epidemic

Figure 3: Skill Premium under Every Case for Scenario 3 before and after the AIDS Epidemic

Figure 4: Skill Premium under Every Case for Scenario 4 before and after the AIDS Epidemic

Figure 5: Skill Premium for Scenario 5 before and after the AIDS Epidemic

Figure 6: Difference Between no AIDS Output and Each Case Relative to Difference Between no AIDS Output and Case c under Scenario 1

Figure 7: Difference Between no AIDS Output and Each Case Relative to Difference Between no AIDS Output and Case c under Scenario 3