A Life Insurance Deterrent to Risky Behavior in Africa

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AIDS Epidemic

- AIDS killed an estimated 2.1 million people worldwide in 2007.
- Between 30.6 and 36.1 million people worldwide currently live with HIV.
- About 2/3 of these people live in Sub-Saharran Africa.
- Worldwide, between 1.8 and 4.1 million new people become infected every year.

HIV/AIDS Prevention Campaigns

- HIV/AIDS funding was around $10 billion in 2007.
  - Almost a 40 fold increase from the previous 10 years.
- Thailand and Cambodia: successful prevention campaigns focused on commercial sex workers.
  - Led to a 90% increase in condom use and 50% reduction in demand.
- Longer-term relationships:
  - Ku, Sonenstein, and Pleck (1994): condom use declines with age and length of relationship.

Reasons for Risky Behavior

- Oster (2007): risky sexual behavior is greater for those with
  - shorter life expectancies,
  - smaller life time incomes.
  - Find decisions of heterosexual males in Sub-Saharran Africa are consistent with homosexual males in United States.
- Becker (1993): Education may increase lifetime income and decrease risky behavior.
- Grossman (1972) and Kenkel (1991): Education may increase access to health information and facilities.
- Can life insurance (paid only if HIV negative) also replicate higher life expectancy and higher lifetime income?

Model Overview

- Model the behavior of adult males with dependents.
- Derive utility and make decisions about:
  1. Personal consumption.
  2. Family consumption.
  3. Number of risky sexual partners.
- Three period model:
  1) Ages 25-39 2) Ages 40-54 3) Ages 55-69
- Agents alive in period 1, possibly die before periods 2 and 3.
  - Probability of dying from something besides AIDS: $\delta \in (0, 1)$
  - Contracting HIV in period t, die of AIDS between t and $t + 1$.

Preferences

- Objective: model men's behavior, how they make choices about consumption, family consumption, sexual partners.
- Utility: economics construct to measure level of satisfaction.
- Every period, utility is derived according to the utility function:

$$u(c_t, f_t, m_t) = v(c_t, f_t) + \gamma_t w(m_t)$$

  - c_t: personal consumption
  - f_t: family consumption
  - m_t: number of sexual partners
  - γ_t measures relative preference for sexual partners.

Preference for Consumption

Log utility over CES personal/family consumption bundle:

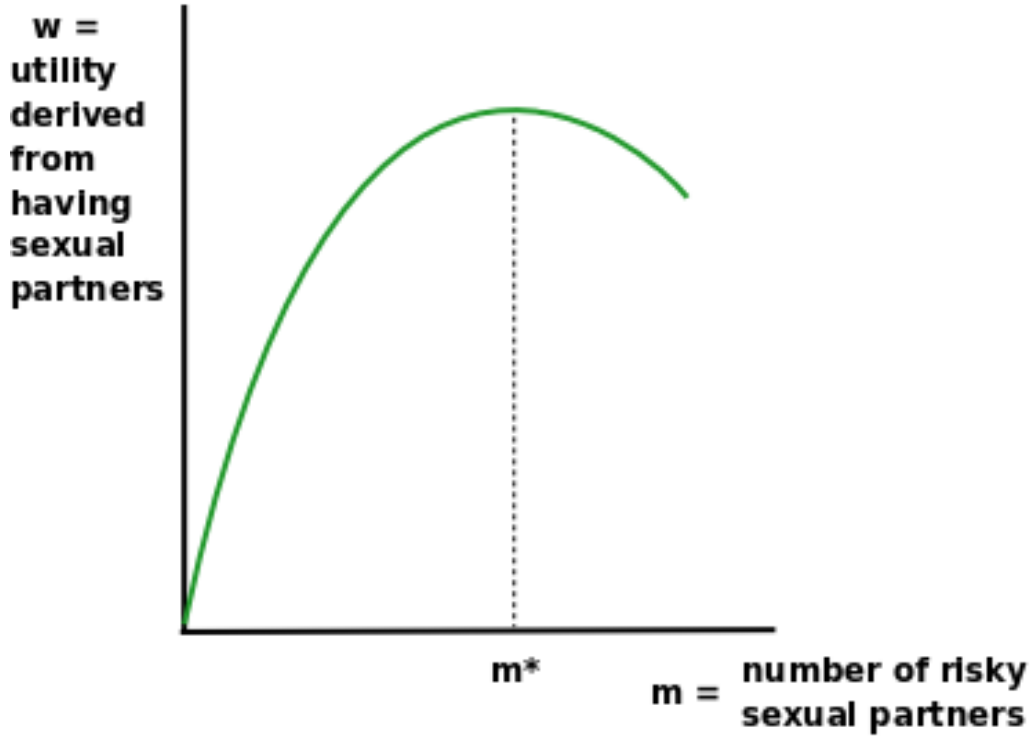
$$v(c_t, f_t) =$$

$$\log\left(\left[\alpha\left(c_t+\epsilon\right)^{\frac{\nu-1}{\nu}}+(1-\alpha)\left(f_t+\epsilon\right)^{\frac{\nu-1}{\nu}}\right]^{\frac{\nu}{\nu-1}}\right)-\log(\epsilon)$$

- α: preference for personal vs family consumption.
- ν: elasticity of substitution personal vs family consumption.
- Men's personal consumption and his family's consumption are (not perfectly) substitutable.

Preference for Sexual Partners

- Assume no sexual partners in final period (ages 55-79).
- Increases in number of sexual partners increases utility...
- Until reach a satiation point m^* where $w'(m^*) = 0$.



$$w(m_t) = \log\left[-(m_t - m^*)^2 + (m^*)^2 + \epsilon\right] - \log(\epsilon)$$

HIV Transmission

- Probability of contracting HIV in period t, die before $t+1$: $\pi(m_t) = 1-(1-ht)^{m_t}$
  - $h \in (0,1)$ be the HIV prevalence among potential partners.
  - $t \in (0,1)$ be the female-to-male transmission rate (per partnership).
  - For a given partner, probability of not contracting HIV: $(1-ht)$.
  - For m_t partners: $(1-ht)^{m_t}$.
- What this means? Probability of contracting HIV increases as...
  - HIV prevalence among partners increases.
  - Transmission rate increases.
  - Number of sexual partners increases.

Expected Life-Cycle Utility

Expected utility over three periods:

$$U = u(c_1, f_1, m_1) + \beta(1-\delta)\left[1-\pi(m_1)\right] u(c_2, f_2, m_2)$$

$$+\beta\left\{1-(1-\delta)\left[1-\pi(m_1)\right]\right\} u(0, f_2, 0)$$

$$+\beta^2(1-\delta)^2\left[1-\pi(m_1)\right]\left[1-\pi(m_2)\right] u(c_3, f_3, 0)$$

$$+\beta^2\left\{1-(1-\delta)^2\left[1-\pi(m_1)\right]\left[1-\pi(m_2)\right]\right\} u(0, f_3, 0)$$

Expected Life-Cycle Budget Constraint

Expected budget constraint over three periods:

$$p_1(c_1 + f_1) + (1-\delta)\left[1-\pi(m_1)\right]\frac{p_2 c_2}{1+r} + \frac{p_2 f_2}{1+r}$$

$$+(1-\delta)^2\left[1-\pi(m_1)\right]\left[1-\pi(m_2)\right]\frac{p_3 c_3}{(1+r)^2} + \frac{p_3 f_3}{(1+r)^2}$$

$$= w_1 + (1-\delta)\left[1-\pi(m_1)\right]\frac{w_2}{1+r} + \delta\left[1-\pi(m_1)\right]\frac{b_2}{1+r}$$

$$+\delta(1-\delta)\left[1-\pi(m_1)\right]\left[1-\pi(m_2)\right]\frac{b_3}{(1+r)^2}$$

- w_1, w_2 are incomes earned during periods 1 and 2.
- b_2, b_3 are possible life insurance payouts.

Solving the Model

- The model has no closed form solution.
- For a given set of parameters, can use numerical methods and computing power.
- Simulate the model for a large range of parameters for...
  - life expectancy (determines δ, the probability of dying from something other than AIDS),
  - income (assume $w_1 = w_2$),
  - size of life insurance benefit (assume $b_1 = b_2$),
  - elasticity of substitution for personal / family consumption, ν.
  - preference for personal over family consumption, α.

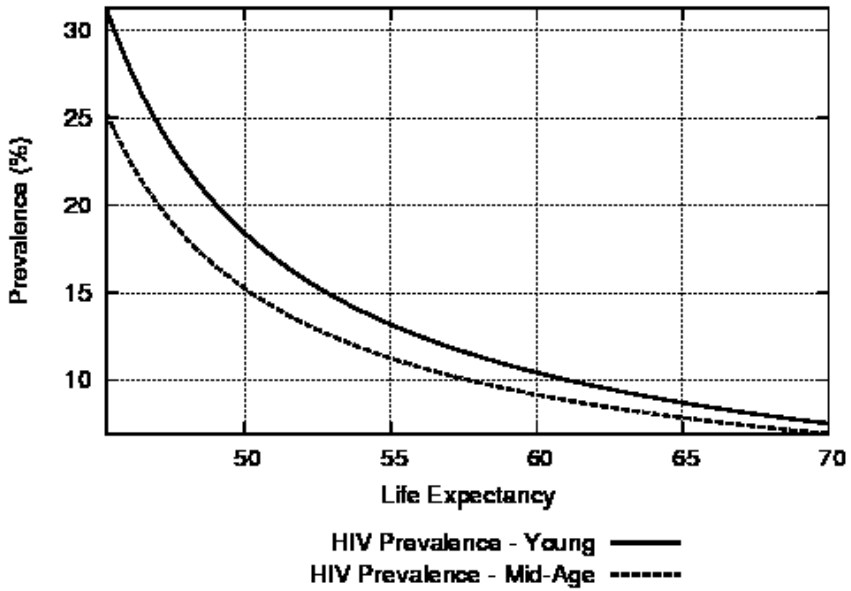
Baseline Parameters

- Data is not available for Sub-Saharran countries to estimate this model.
- Some parameters are set to match situation in Zambia:
  - Overall HIV Prevalence among women (potential partners): $h = 0.161$.
  - Income over 15 years for a family of 4: $w_1 = w_2 = \$22{,}440$ (US dollars, constant 2000 prices).
  - Exogenous probability of dying: $\delta = 0.508$ (Non-AIDS life expectancy for men 51 years).
- Other parameters we have good guesses for:
  - Transmission rate: $t = 0.15$.
  - Interest rate / Discount rate (15 year period): $r = 0.82$, $\beta = 0.547$.

Baseline Preference Parameters

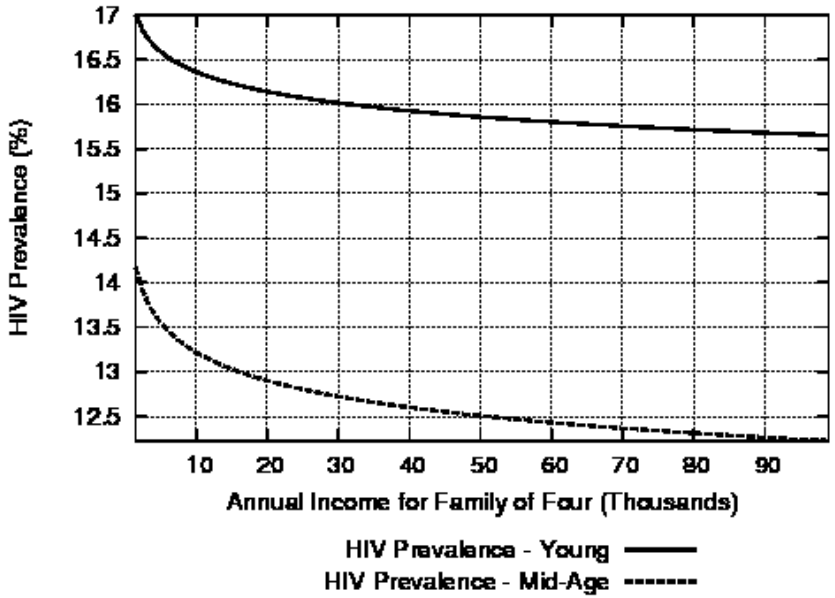
- Some utility function parameters we just completely make up:
  - Personal consumption preference parameter: $\alpha = 0.5$.
  - Elasticity of substitution personal/family consumption: $\nu = 1.0$.
  - Satiation point: $m^* = 50$.
- Set the utility function sexual partners to match HIV prevalence rates among men in Zambia:
  - $\gamma_1 = 1.360$, leads to HIV prevalence among men ages 25-39, $\pi(m_1) = 0.170$.
  - $\gamma_2 = 0.501$, leads to HIV prevalence among men ages 40-54, $\pi(m_2) = 0.142$.

HIV Prevalence: Life Expectancy



- HIV prevalence among adult men can decrease from 17% (young) and 14% (middle-age) to about 7%.
- Shortening life expectancy can result in big increases in HIV prevalence.
- Likely *under-estimates* true effect, since h remains constant ($h = 0.161$).

HIV Prevalence: Income

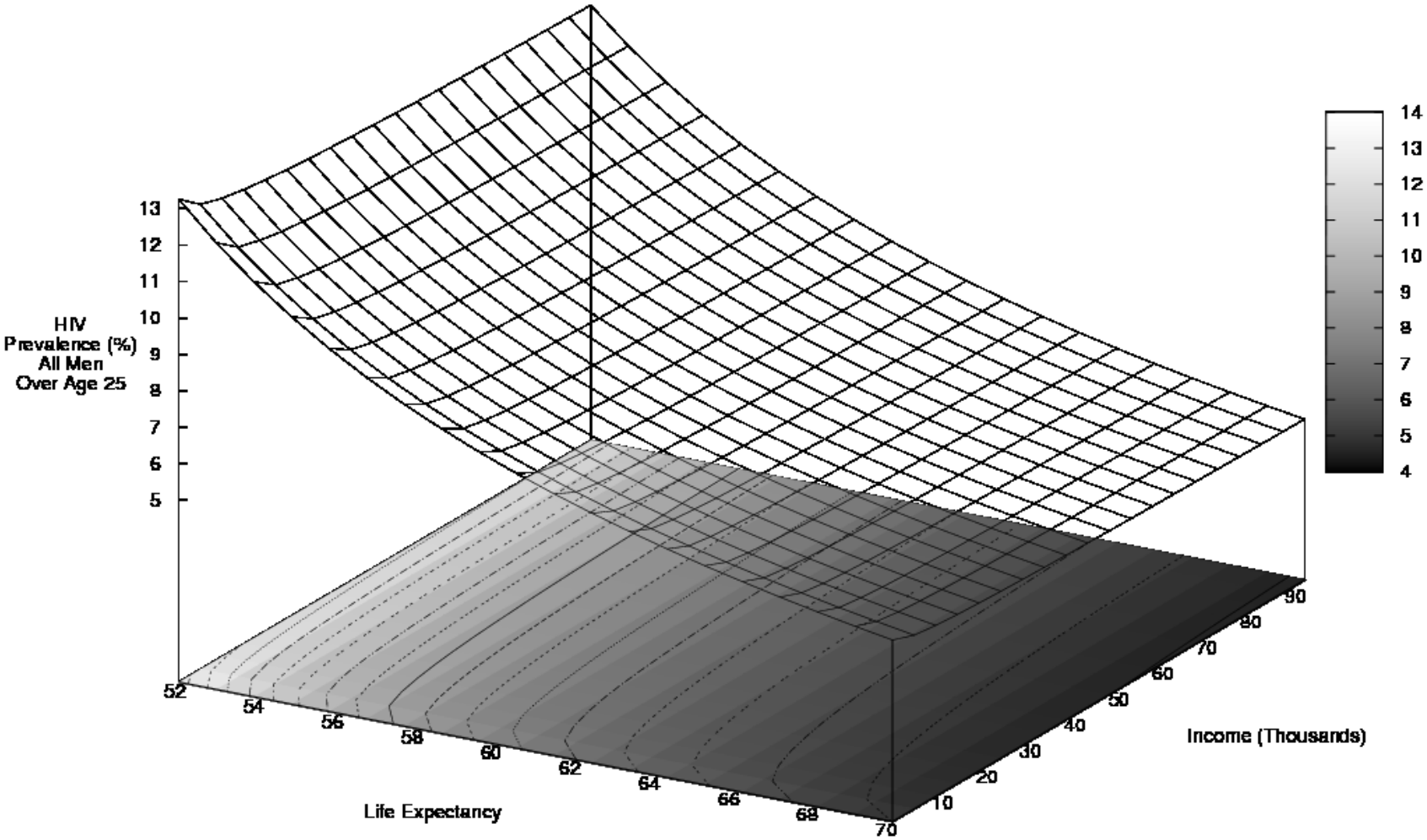


- Smaller responses to increases in income.
- For Age 25-39, possible decrease in prevalence from 17% to about 15.7% (7.6% reduction in men with HIV).
- For Age 40-54, possible decrease in prevalence from 14.2% to about 12.3% (13.4% reduction in men with HIV).

HIV Prevalence: Income

- Deterrence effect of higher income is not as great as deterrence effect of longer non-AIDS life expectancy.
- Two effects of an increase in income
- Substitution effect: causes a decrease in risky behavior (greater opportunity cost to risky behavior).
- Income effect: causes an increase in risky behavior (greater ability to pay for all goods).
- Substitution effect is small when life expectancy is short, this is why effect on income is so small.

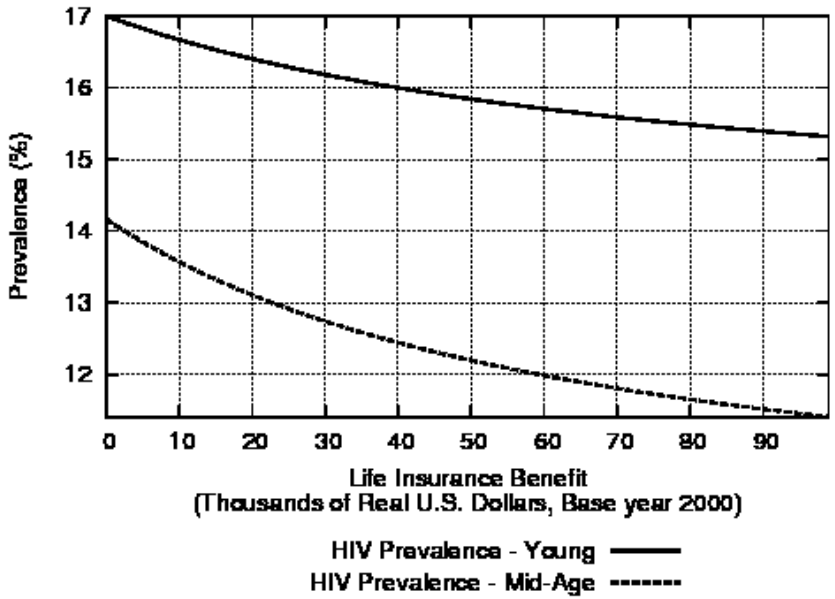
HIV Prevalence: Life Expectancy and Income



HIV Prevalence: Life Expectancy and Income

- Increased life expectancy can be a large deterrent to risky behavior.
- Increased income is a relatively smaller deterrent.
- Deterrence effects of life expectancy and income complement each other.
- Can life insurance payouts replicate these effects?
  - Notice: utility functions value family consumption even after a possible death.

HIV Prevalence: Life Insurance Benefit

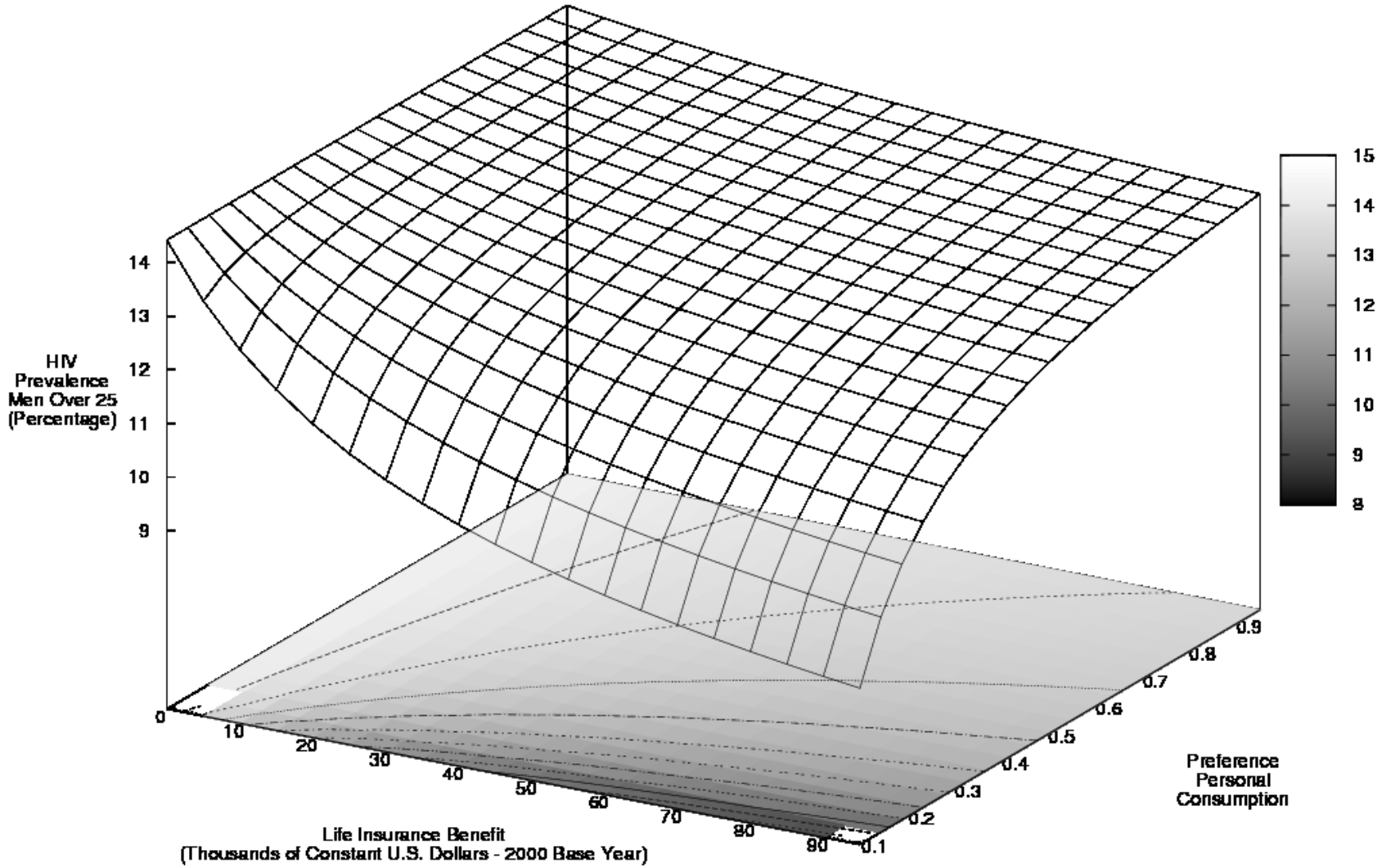


- Life insurance benefit mirrors effect of income, not so much life expectancy.

Determinants of Life Insurance Effectiveness

- Uncertain calibrations for:
  - Preference for personal over family consumption, α.
  - Substitutability of personal and family consumption, ν.
- Life insurance should be more effective if...
  - individuals care more about family consumption (lower α).
  - family and personal consumption are more highly substitutable (higher ν).

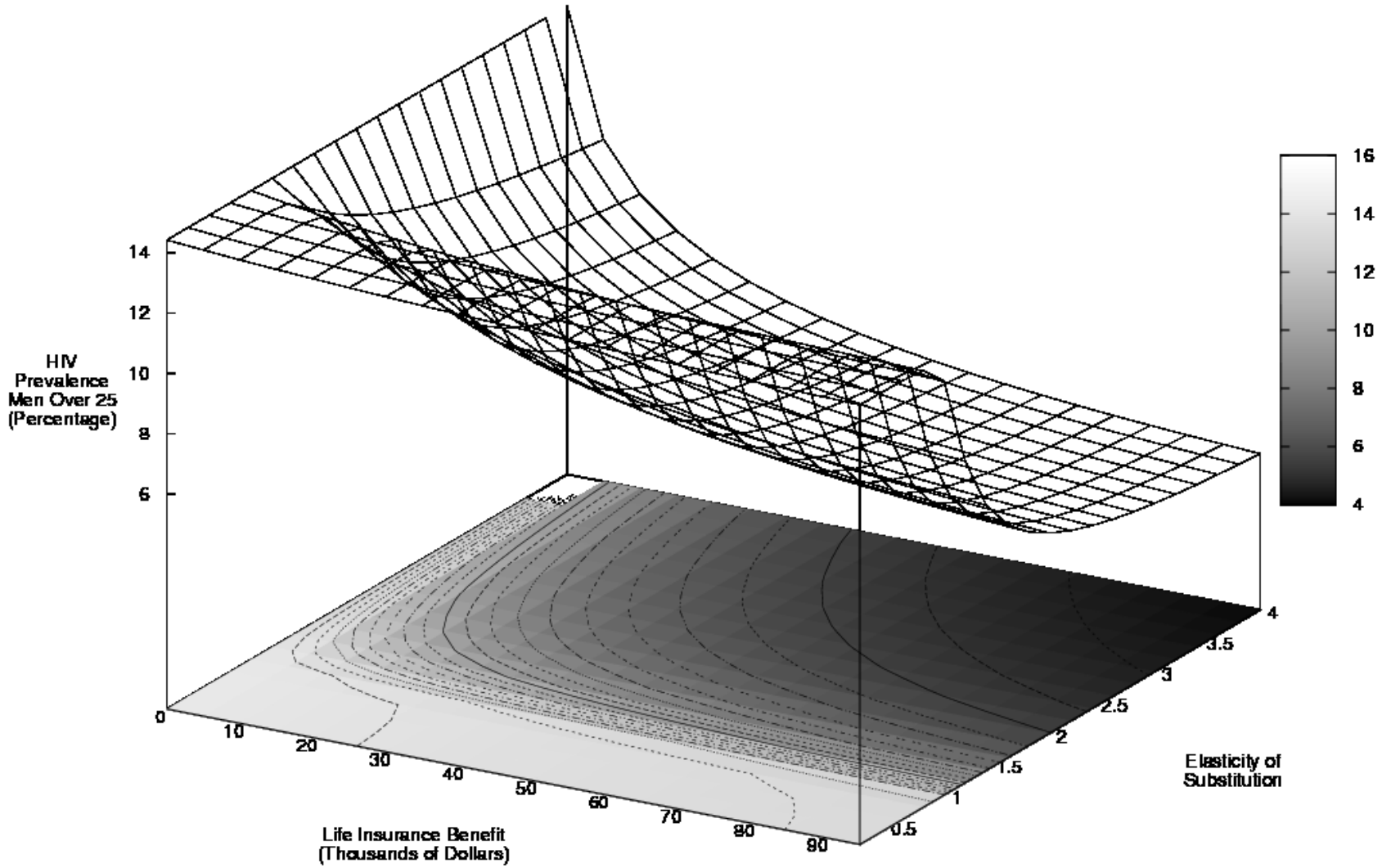
Life Insurance: Value for Personal Consumption



Life Insurance: Value for Personal Consumption

- As α gets larger, the *greater* is deterrence effect of an *increase in income* (not shown).
  - Increases substitution effect: greater selfishness increases the opportunity cost of risky behavior.
- However, as α gets larger, the *smaller* is going to be the effectiveness of life insurance benefits.
  - Life insurance is paid out only if dead and can only finance family consumption.

Life Insurance: Elasticity of Substitution



Life Insurance: Elasticity of Substitution

- As ν gets larger, the *smaller* is deterrence effect of an *increase in income* (not shown).
  - Decreases the substitution effect: family consumption (which can be enjoyed when dead) makes a suitable substitute for personal consumption.
- However, as ν gets larger, the *greater* is going to be the decrease in risky sexual activity and HIV prevalence in response to an *increase in income*.
  - If family consumption (can be enjoyed if dead) and personal consumption (only if alive) are highly substitutable, life insurance can have a similar effect of increasing life expectancy.

Discovering Preference Parameters

- Finding evidence or computing estimates for preference parameters is left for future research.
- Interview evidence may shed light on α (value of personal vs family consumption).
- If people in countries with higher incomes but low life expectancies have little differences in risky sexual behavior:
  - α is likely small (greater value for family consumption).
  - ν is likely large (family and personal consumption are highly substitutable).
  - Perhaps counter-intuitively, the *more* effective will be a government provided life-insurance policy.

Conclusion

- Life-cycle model
  - Low life expectancy and low income leads to highly risky behavior.
  - High life expectancy and high income leads to much safer behavior.
- Life insurance can replicate small effects of a high income.
- Life insurance can replicate large effects of *both* a high income and high life expectancy,
  - if value for personal consumption versus family consumption is low and/or
  - if elasticity of substitution between personal and family consumption is high.
- Easy for life insurance deterrent to have large coverage.
- Should encourage HIV testing, complement existing prevention measures.