Health and Inequality

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Work in Progress

Introduction

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▷ We want to *compare* and *relate* *inequality in health outcomes* to pure *economic inequality*.

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b/ Health-improving technology with medical expenditures

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1. Do welfare analysis, i.e. compare the fate of different groups given their allocations.
2. Ask what different groups would do if their resources were different and how much does welfare change.

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▷ Part (3) still preliminary

Welfare Comparison: Compensated Variation

1. Under the same preferences $u(c)$, then to make them equally happy, we have to set $u(\overline{c}_d) = u(c_c)$, i.e. to give $\frac{\overline{c}_d}{c_d} - 1$ extra consumption to the d group.

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2. If they have different longevities, then we have to use a u function that includes consumption and and the value of expected longevity ℓ: $u(c, \ell)$. Then the compensated variation be the amount $\frac{\overline{c}_d}{c_d} - 1$ that solves

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3. If their health differs, u has to take health and longevity into account. The compensated variation does not change health or longevity. $u(\overline{c}_d, \ell_d, h_d) = u(c_c, \ell_c, h_c)$

The Logic, Consider, dropouts and college graduates, d and c

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4. If we estimate preferences and health maintenance technology when compensating people, they would alter their health and longevity in ways we could calculate.

Stylized Model: The construction of u

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6. Let health $h \in \{h_g, h_b\}$

$$V^e(a,h) = \max_{x,c,a'_{h'}} \left\{ u(c,h) + \beta\, \gamma_h \sum_{h'} \Gamma^e_{hh'}(x)\ V^e(a'_{h'}, h') \right\}$$

$$\text{s.t.} \quad x + c + \gamma_h \sum_{h'} q^e_{hh'}\ a'_{h'} = a(1+r)$$

- In equilibrium $(1+r) = \beta^{-1}$ and $q^e_{hh'} = \Gamma^e_{hh'}$

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- In equilibrium $(1+r) = \beta^{-1}$ and $q^e_{hh'} = \Gamma^e_{hh'}$
- Standard Complete Market result (Euler equation for c):

$$\chi_g \frac{1}{c_g} = \chi_b \frac{1}{c_b} \qquad \text{and} \qquad c_g = c'_g,\; c_b = c'_b$$

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- Optimal health investment (Euler equation for x):

$$u_c(c_h,h) = \beta\,\gamma_h\,\frac{\partial \Gamma^e_{hh_g}(x)}{\partial x}\;\Big(V^e(a'_{h_g},h_g) - V^e(a'_{h_b},h_b) \Big)$$

Welfare comparisions

- The attained value in each health state is given by

$$\begin{pmatrix} V_g^e \\ V_b^e \end{pmatrix} = A^e \begin{pmatrix} \alpha_g + \chi_g \log c_g^e \\ \alpha_b + \chi_b \log \frac{\chi_b}{\chi_g} c_g^e \end{pmatrix}$$

where $$A^e = \left[I - \beta \begin{pmatrix} \gamma_g & 0 \\ 0 & \gamma_b \end{pmatrix} \begin{pmatrix} \Gamma_{gg}^e(x_g^e) & 1 - \Gamma_{gg}^e(x_g^e) \\ \Gamma_{bg}^e(x_g^e) & 1 - \Gamma_{bg}^e(x_g^e) \end{pmatrix} \right]^{-1}$$

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Results without Endogeneous Health

Welfare differences without endogenous health

Welfare of different types

	CG	HSG	HSD	CG-HSG	CG-HSD

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- Our answer

  By revealed preference, it must be that out-of-pocket health spending is not too useful in improving health after age 50

Results with Endogeneous Health

Functional form

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- This adds 8 parameters: ν_g, ν_b $\lambda_{1,g}$,$\lambda_{1,b}$ $\lambda^c_{0,g}$, $\lambda^c_{0,b}$, $\lambda^d_{0,g}$, $\lambda^d_{0,b}$

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2. The 4 observed health transitions yield the $\lambda_{0,h}^e$ for e and $h \in \{g, b\}$.

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  - This is because of low ratio of medical to non-medical expenditure (0.18)

Panel A: Health Transition Parameters

	Γ_{hg}	λ^e_{0h}	λ_{1h}	ν_h
Good health				
College	0.951	0.935	3.5×10^{-5}	0.35
Dropouts	0.895	0.884		
Bad health				
College	0.386	0.367	1.6×10^{-5}	0.25
Dropouts	0.125	0.114		

Panel B: Decomposition of the Life Expectancy Gradient

	Full model	μ^c	x^c	λ^c_{0h}
Life expectancy	5.6	0.7	0.3	4.8
Healthy life expectancy	13.2	1.8	0.7	11.5

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Health diff: none	1.25	1.64
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- This is still a very large difference.

Quantitative Model

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   - Distribution: $\log \epsilon \sim N\left(-\frac{1}{2}\sigma_\epsilon^2, \sigma_\epsilon^2\right)$

The Bellman equation: The retiree version

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- Subject to the budget constraint and the law of motion for cash in hand

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Two types of First Order Conditions

- Consumption

$$u_c^i[h, c(\omega)] = \beta^e \gamma^i(h) R \sum_{h' \eta} \pi_\eta^{ih} \int_\epsilon \Gamma^{ei}[h' \mid h, \eta, x(\omega, \eta)\epsilon] \; u_c^{i+1}\left[h', c\left(\omega, \eta, h', \epsilon\right)\right] f(d\epsilon)$$

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- Health investments at each state η:

$$R \sum_{h'} \int_\epsilon \epsilon \, \Gamma^{ei}[h' \mid h, \eta, x(\omega, \eta)\epsilon] \; u_c^{i+1}[h', c\left(\omega, \eta, h', \epsilon\right)] \; f(d\epsilon) =$$

$$\sum_{h'} \int_\epsilon \epsilon \, \Gamma_x^{ei}[h' \mid h, \eta, x(\omega, \eta)\epsilon] \; v^{e,i+1}\{h', a'\left(\omega, \eta, \epsilon\right)\} \;\; f(d\epsilon)$$

Estimation

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  - Need to recover posterior probability of η_j from observed health spending $\tilde{x}_j$

Preliminary Estimates: Preferences

Consumption Euler equation

- We use the sample average for all individuals j of the same type ω as a proxy for the expectation over η, h', and ϵ

$$\beta^e R \, \tilde{\gamma}_h^i \frac{1}{N_\omega} \sum_j \mathbf{I}_{\omega_j=\omega} \frac{\chi_{h'_j}^{i+1}}{\chi_h^i} \left(\frac{c'_j}{c_j} \right)^{-\sigma} = 1 \qquad \forall \omega \in \widetilde{\Omega}$$

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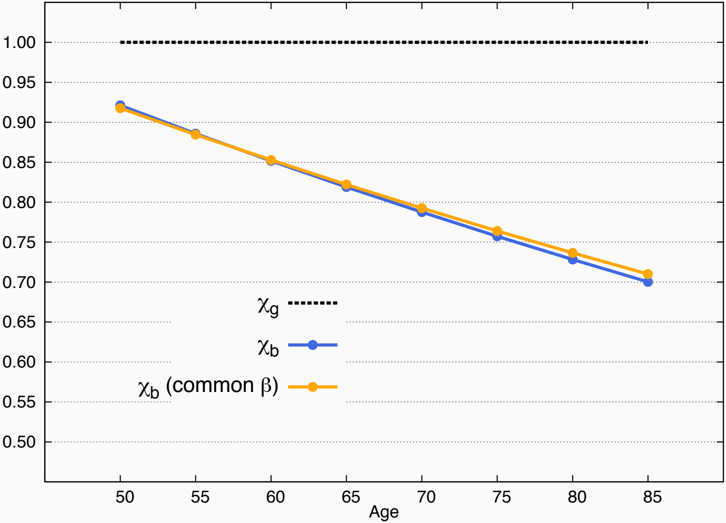
3. Uneducated are NOT more impatient: they have worse health outlook

Results

Men sample (with $r = 2\%$)

	β edu specific		β common	
σ	1.5		1.5	
β^d **(s.e.)**	0.8861	**(0.0175)**	0.8720	**(0.0064)**
β^h **(s.e.)**	0.8755	**(0.0092)**	0.8720	**(0.0064)**
β^c **(s.e.)**	0.8634	**(0.0100)**	0.8720	**(0.0064)**
χ_b^0 **(s.e.)**	0.9211	**(0.0575)**	0.9176	**(0.0570)**
χ_b^1 **(s.e.)**	-0.0078	**(0.0035)**	-0.0073	**(0.0035)**
observations	15,432		15,432	
moment conditions	240		240	
parameters	5		3	
α_g			0.066	
α_b			0.048	

Results



1.00
0.95
0.90
0.85
0.80
0.75
0.70
0.65
0.60
0.55
0.50
50
55
60
65
70
75
80
85
Age
χ_g
χ_b
χ_b (common β)

Preliminary Estimates: Health Technology

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  - Health spending Euler equation: $\forall \omega \in \widetilde{\Omega}$ and $\forall \eta \in \{\eta_g, \eta_b\}$

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  - Health transitions: $\forall \omega \in \widetilde{\Omega}$

$$\widetilde{\Gamma}\left(h_g \mid \omega\right) = \sum_{\eta} \pi_{\eta}^{ih} \left(\lambda_{0\eta}^{ieh} + \frac{\lambda_{1\eta}^{ieh}}{1-\nu^{ih}} \frac{1}{M_{\omega}} \sum_j \mathbf{I}_{\omega_j=\omega} \widetilde{x}_j^{1-\nu^{ih}} Pr\left[\eta|\omega_j, \widetilde{x}_j\right] \right)$$

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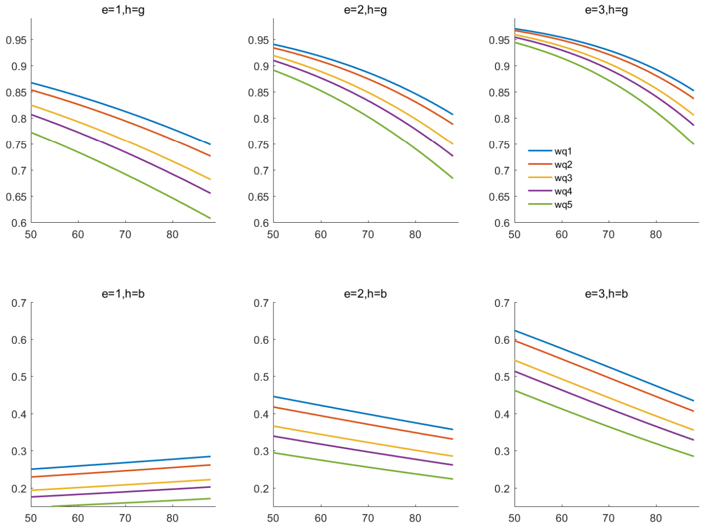
  - And we weight every individual observation by this probability

The Problem

- Finally, need to estimate
  - the contingent health spending rule $x(\omega, \eta)$
  - the probability distribution of health outlooks sock, $\pi^{ih}_{\eta_g}$
  - the variance of the medical implementation error, σ^2_ϵ
- We identify all these objects through the observed health transitions $\widetilde{\varphi}(h_g|\omega, \tilde{x})$ as function of the state ω and health spending $\tilde{x}$

$$\underbrace{Pr[h_g|\omega, \widetilde{x}]}_{observed\ \ in\ \ the\ \ data} = \Gamma^{ei}[h_g \mid h, \eta_g, \widetilde{x}] \underbrace{Pr[\eta_g|\omega, \widetilde{x}]}_{posterior} + \Gamma^{ei}[h_g \mid h, \eta_b, \widetilde{x}] \underbrace{Pr[\eta_b|\omega, \widetilde{x}]}_{posterior}$$

Average health transitions



Preliminary estimtes

Implications for health transitions

- We have preliminary estimates of health technology parameters $\theta_2 = \{\lambda_{0\eta}^{ieh}, \lambda_{1\eta}^{eh}, \nu^{ih}, \pi_{\eta}^{ih}, \sigma_{\epsilon}^2\}$
- They generate health transitions that are consistent with
  - More educated have better transitions
  - Wealthier have better transitions
  - Older have worse transitions
- However, quantitatively, two problems remain
  - Worsening of health transitions with age milder than in the data (for some types)
  - Dispersion of transitions with wealth smaller than in the data

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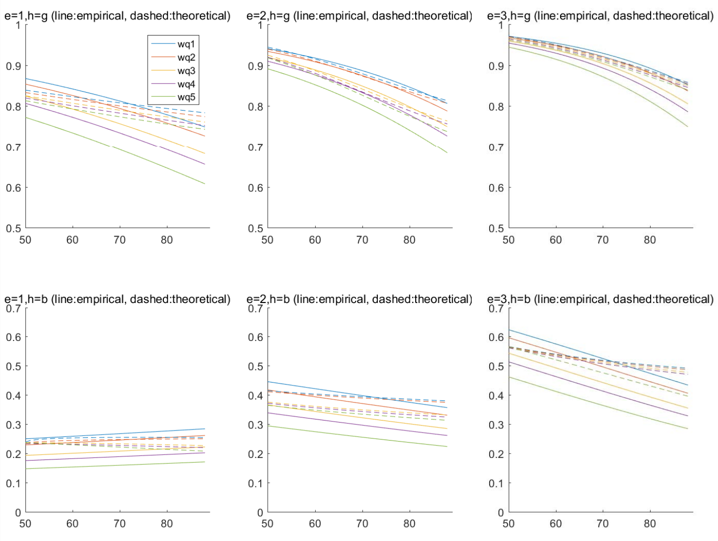

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  - Fully-fledged life cycle model without complete markets and trace its welfare implications.
  - So far not that different from calibrated simple version.

Remaining Important Issues

1. Estimation is closely dependant on U.S. features
   - Limited health insurance.
   - Not well defined role of Out of Pocket Expenditures. We are not sure if it means the same things across education groups.
2. Would love to use non U.S. data