Health and Heterogeneity

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Introduction

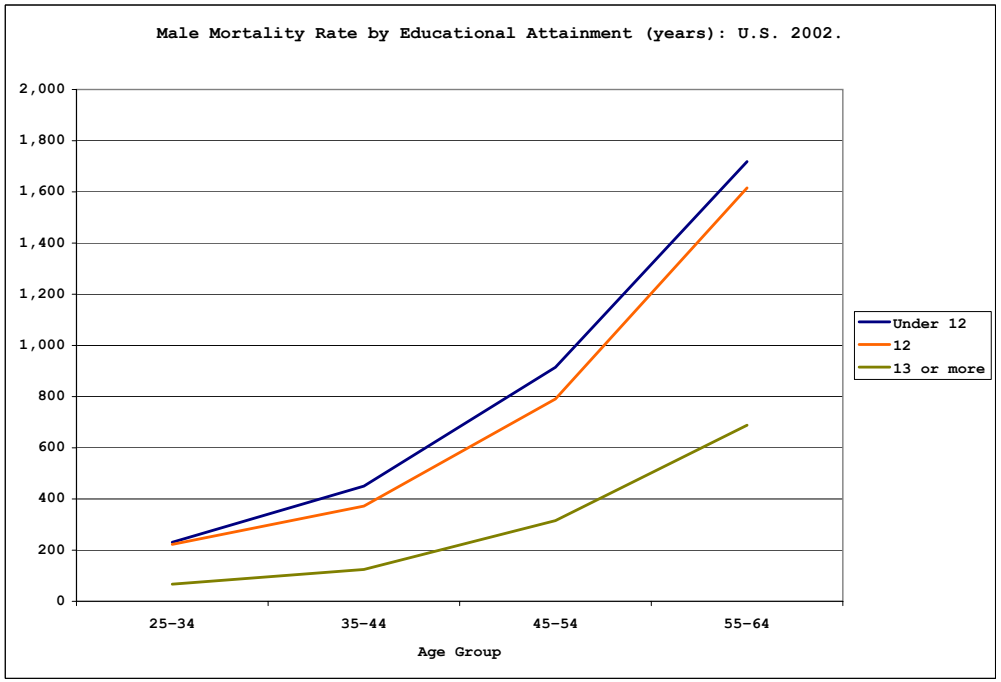
• People are different in many ways: Income and Wealth, Education and Marital Status, or Health Related Behavior and Survival Rates.

• As economists, we want to know whether people differ in their decisions through life because different things happen to them or because they are intrinsically different.

• If the latter, in which dimensions people are different?

• We will exploit data on health outcomes and health investment to find out.

Death rates and economics (education) are related



Health measures and economics (education) are related ...

• Self rated health is a very good predictor of mortality (Idler and and Benyamini, 1997), even when controlling for socio-economic variables and medical conditions.

Health	*share of individ. (%)*		
	$e = d$	$e = h$	$e = c$
excellent	9.1	55.5	35.4
very good	11.9	58.7	29.4
good	23.6	58.0	18.3
fair	30.0	60.5	9.5
poor	48.2	42.0	9.9

Note: Males aged 54-59, from HRS.

▶ The proportion of highly educated individuals is increasing by health category

... assets and income also matter ...

Health	*Assets*		*Income*	
	mean	*med*	*mean*	*med*
excellent	194.1	103.8	46.7	34.9
very good	197.4	87.5	45.7	30.5
good	127.0	59.0	32.0	24.6
fair	99.4	34.6	25.6	16.2
poor	40.2	21.6	14.6	10.8

Note: Males aged 54-59, from HRS. Thousands of 1992 dollars.

- Both wealth and income increase with the health status

... even if we separate them. First, conditional on education wealth still matters;

Health	$e = d$		$e = h$		$e = c$	
	mean	*med*	*mean*	*med*	*mean*	*med*
exc. or v.g.	91.1	45.0	156.42	81.4	303.8	148.2
good	45.2	30.8	125.9	64.0	235.6	122.5
fair or poor	39.4	13.2	97.1	41.4	160.6	65.3

Note: Males aged 54-59, from HRS. Thousands of 1992 dollars.

▶ Conditional on education, the average and median wealth are also increasing by health category.

second, conditional on wealth educations matters.

Wealth	*Health*	*share of individ. (%)*		
		$e = d$	$e = h$	$e = c$
Poorest quartile	*exc. or v.g.*	22.6	63.7	13.7
	good	37.9	52.9	9.3
	fair or poor	46.8	46.1	7.1
Second quartile	*exc. or v.g.*	14.4	62.9	22.8
	good	30.1	57.5	12.3
	fair or poor	40.3	53.2	6.5
Third quartile	*exc. or v.g.*	7.8	61.2	31.0
	good	11.3	68.7	20.0
	fair or poor	11.5	78.9	9.6
Richest quartile	*exc. or v.g.*	5.1	46.5	48.3
	good	6.7	53.3	40.0
	fair or poor	13.9	61.1	25.0

Note: Males aged 54-59, from HRS.

▶ Conditional on asset category, the proportion of highly educated individuals is increasing by health category

Health outcomes and economics (education) are related.

Various possibilities of why

1. Better education $\Rightarrow$ more income $\Rightarrow$ you buy better health.

2. Schooling develops different tastes and attitudes.

3. Schooling allows to produce better health.

4. Old age is relatively more enjoyable with more educ/money.

5. There is a (are) third variables(s) that influence both schooling and health choices.

Some facts:

• The relationship between health and schooling persists once we control for income and other socio-economic variables (Grossman, 1973). Therefore, hypo 1, insufficient.

• A gradient of smoking behavior with years of schooling persists (and is very strong) when smoking is measured at age 17, before the later years of schooling are completed (Farrell and Fuchs, 1982). Therefore, hypo 2 seems also insufficient.

• Kenkel (1991) shows that the relationship between smoking, drinking and exercise habits and education persists once we control for individuals knowledge of their effects on health. Hence, hypo 3 not enough.

Health and human capital

▶ Hypos 4 and 5 point to the traditional idea of human capital investment:

- Human capital, measured as either education or health, requires some investment in the sense that one has to sacrifice current utility in order to build it.
- Any variable affecting the trade-off between current and future utilities should equally affect education and health.
- Their respective investments maybe complimentary.

▶ We will try to exploit individual level data on health outcomes, wealth and education levels to learn about how to think about types of people.

Health investment correlates with education: smoking

	mar m	sing m	mar f	sing f
edu=d	0.32	0.46	0.27	0.32
edu=h	0.21	0.36	0.18	0.27
edu=c	0.12	0.22	0.08	0.13

Note: all individuals, from HRS.

- As known, more educated people smoke less.
- But also females and married people.

Health investment correlates with education: cholesterol tests.

	mar m	sing m	mar f	sing f
edu=d	0.58	0.47	0.68	0.65
edu=h	0.71	0.59	0.73	0.69
edu=c	0.79	0.68	0.80	0.73

Note: all individuals, from HRS.

- More educated people are more likely of having had a cholesterol test in the last two years.

- Also married individuals and females invest more in health

- The same behavior arises with flu vaccination and breast and prostrate cancer tests.

Some related work

• Belzil and Hansen (1999) claim that differences in β are important to explain observed years of education, wages and unemployment, and that discount rates are correlated with ability (more able are more patient).

• Using the NLSY, Munasinghe and Sicherman (2000) show that non-smokers self select into professions with higher wage growth.

The Model: Exogenous Variables

First the types (fixed heterogeneity),

- Taste for health-related behavior z
- Patience β
- Ability to earn η
- Ability to learn θ

Let $\tau = \{z, \beta, \eta\}$ denote a subset of types.

▶ Since we will only focus on first and second moments, we can state

$$[z, \beta, \eta, \theta] \sim N(\mu, \Sigma)$$

The Model: Exogenous Variables

Next the shocks

- Labor earnings shock ϵ with transition $\Gamma_{\epsilon,\epsilon'}$
- Shock to health ζ that affects (deteriorates) health, it is i.i.d.

The Model: Preferences and Endogenous States

- Individuals live for a maximum of I periods.
- Within period utility function, $u^z(c, y)$ (health investments).
- Health stock h evolves stochastically $h' = \phi_i(\zeta, h, y)$
- Health improves survival odds, $\gamma^i(h)$.

The endogenous state variables are:

- Education $e \in E \equiv \{e_1, e_2, ...e_{n_e}\}$ Chosen when young.
- Wealth $a \in A \equiv [\underline{a}, \infty)$ updated every period.
- Health $h \in H \subset \mathbb{R}_+$ updated every period.

The Model: the optimization problem

- Agent's problem at $i > 0$,

$$V^{\tau,e,i}(\epsilon,a,h) = \max_{c,y,a',h'} \left\{ u^z(c,y) + \beta\,\gamma^i(h)\; E_{\zeta',\epsilon'|\epsilon}\left[V^{\tau,e,i+1}\left(\epsilon',a',h'\right)\right]\right\}$$

$$\text{with} \qquad \begin{aligned} c + a' &= R\,a + w\,e\,\eta\,\epsilon \\ h' &= \psi\left(\zeta', h, y\right) \end{aligned}$$

Notice that the problem is not indexed by θ.

- At $i = 0$, *youth*, individuals choose their education level e.

$$\max_{e,y,a'} \left\{ W^{\tau,\theta}\left(a,a',e,\epsilon,y\right) + \beta\gamma^1(h)\, E_{\zeta',\epsilon'|\epsilon}\left[V^{\tau,e,1}\left(\epsilon',a',\psi\left(\zeta',h,y\right)\right)\right]\right\}$$

with a yet to be determined current return $W(.)$

The Consumption Euler Equation

The first Euler equation is standard,

$$u_c^z(c,y) = R\,\beta\,\gamma^i(h)\;E_{\zeta',\epsilon'|\epsilon}\left[u_c^z\left(c',y'\right)\right]$$

• If consumption and health related behavior are separable, $u_c^z(c,y) = u_c(c)$, then age profiles of c only differ due to $\{h,\epsilon,\beta\}$.

• If we only look at retirees (possibly 65 or older to avoid self-selection), we have

$$u_c(c) = R\,\beta\,\gamma^i(h)\;E_{\zeta'}\left[u_c\left(c'\right)\right]$$

▶ Then, If h is observable, the age-profiles for c reveal differences in time preferences, β. We need a data set containing at the same time health status, income and consumption (or wealth instead of consumption).

The Health Euler Equation

The FOC condition:

$$-u_y^z(y) = \beta\,\gamma^i(h)\;E_{\zeta',\epsilon'|\epsilon}\left[\psi_y\left(\zeta',h,y\right)V_h^{\tau,e,i+1}\left(\epsilon',a',h'\right)\right]$$

and the envelope condition:

$$\begin{aligned} V_h^{\tau,e,i}(\epsilon,a,h) &= \beta\,\gamma_h^i(h)\,E_{\zeta',\epsilon'|\epsilon}\left[V^{\tau,e,i+1}\left(\epsilon',a',h'\right)\right]+ \\ &+ \beta\,\gamma^i(h)\,E_{\zeta',\epsilon'|\epsilon}\left[\psi_h\left(\zeta',h,y\right)V_h^{\tau,e,i+1}\left(\epsilon',a',h'\right)\right] \end{aligned}$$

- It is crucial to identify

1. the relationship between health investment and health stock,

$$h' = \psi\left(\zeta', h, y\right)$$

2. the predictive power of health stocks for survival probabilities,

$$\gamma^i\left(h\right)$$

▶ With information on these two elements, differences in observed y within individuals with same assets a, education e, earnings categories ϵ and η and patience β will be accounted for differences in z.

The Educational Choice

Finally, the optimality condition at *youth* that sorts out people in different educational categories will give us information on the ability to learn or utility cost of education θ once we have already inferred values for β, z and η.

• Note that all the fixed heterogeneity elements, z, β, η and θ may generate $corr\,(e,h) > 0$

▶ By using the model, we want to infer the relative importance of each source of fixed heterogeneity and their (possible) correlations.

Mapping the Model to Data

- We needed to know (Possibly only one of them age dependent)

1. the relationship health and harmful behavior, $\psi^i(\zeta', h, y)$
2. the survival probabilities at different health levels $\gamma^i(h)$

- HRS reports several measures of health stock (self-rated health, diagnosed conditions) and various measures of health behavior (smoking, exercise habits, cholesterol tests, cancer tests, ...).

- Additionally, HRS reports self-assessed probabilities of survival to age 75 and 85. Hurd and McGarry (1993, 1995) show they correlate very well with risk factors and that they actually predict mortality.

Targets for Identification of Types

1. Given an observation of h, consumption growth identifies β.

2. Given an observation of the whole state (ϵ, a, h), variation in health investment among retirees identifies z.

3. We can use earnings analysis directly to get η.

4. The positive correlation between education and health.

5. The Education Distribution given wage levels per generation (helps with θ).

These variables have to be jointly observed.