Health and Heterogeneity

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Extremely Preliminary

Part I

Data

Known facts

- Empirical evidence: **health** and **education** are **positively** related

  Grossman (1975); Grossman and Kaestner (1997)

- **More educated** also face **lower mortality** rates

  Kitagawa and Hauser (1973); Elo and Preston (1996)

- In addition, **more educated** also *do better things* for their health

  Cutler and Glaesser (2005)

- We want to understand the **sources of heterogeneity** between people that are behind the correlation between health and education

The Health and Retirement Study

- Bi-annual panel, 9 waves, from 1992 to 2008
- Initial HRS cohort aged 50-61 in 1992 and 66-77 in 2008
- Two additional younger cohorts and two additional older cohorts
- This gives around 125,000 individual-year observations
  (white, aged 50-95, non-missing)
- Rich socio-economic data
  (marital status, education, income, wealth)
- Rich health related data:
  - health stock: self-assessed and diagnostics
  - health investment: expenditures and behavior
  - mortality: keep track of mortality

Comparison to National Vital Statistics Data

Life Expectancies

Source	*Male*	*Female*	*Gap*
NVS 96	27.5	31.7	4.2
NVS 00	28.2	32.0	4.2
NVS 05	29.1	32.9	3.8
HRS 92-07	28.1	31.9	3.8

Life Expectancies at age 50, white population.

Life Expectancies

Death rates, education

Source	*Male 55-64*				*Female 55-64*			
	HSD	*HSG*	*CG*	*gap*	*HSD*	*HSG*	*CG*	*gap*
NVS 96	1.76	1.66	0.83	0.93	0.97	0.94	0.52	0.45
NVS 00	1.81	1.59	0.73	1.08	1.00	0.93	0.49	0.51
NVS 05	2.00	1.47	0.67	1.33	1.16	0.88	0.44	0.72
HRS 92-07	2.04	1.46	0.81	1.23	1.41	0.83	0.37	1.04
HRS 92-07 (white)	1.90	1.35	0.80	1.10	1.13	0.71	0.29	0.84

Death rates: dead people per 100. All races, unless stated

Death rates, marital status

Death rates, marital status

Source	*Male 55-64*			*Female 55-64*		
	m	*nm*	*gap*	*m*	*nm*	*gap*
NVS 96 (white)	1.05	2.47	1.42	0.62	1.18	0.56
NVS 00 (white)	0.93	2.12	1.19	0.57	1.11	0.54
NVS 05	0.81	2.19	1.38	0.51	1.07	0.56
HRS 92-07	1.24	2.53	1.29	0.66	1.39	0.73
HRS 92-07 (white)	1.17	2.19	1.02	0.61	1.05	0.44

Death rates: dead people per 100. All races, unless stated.

Survival probabilities

Education and health

1) Survival increases between **education** groups

   - within education groups, survival increases with assets
   - sample of non-retired: survival increases with earnings, not with assets

     (sample of retired: survival still increases with assets)

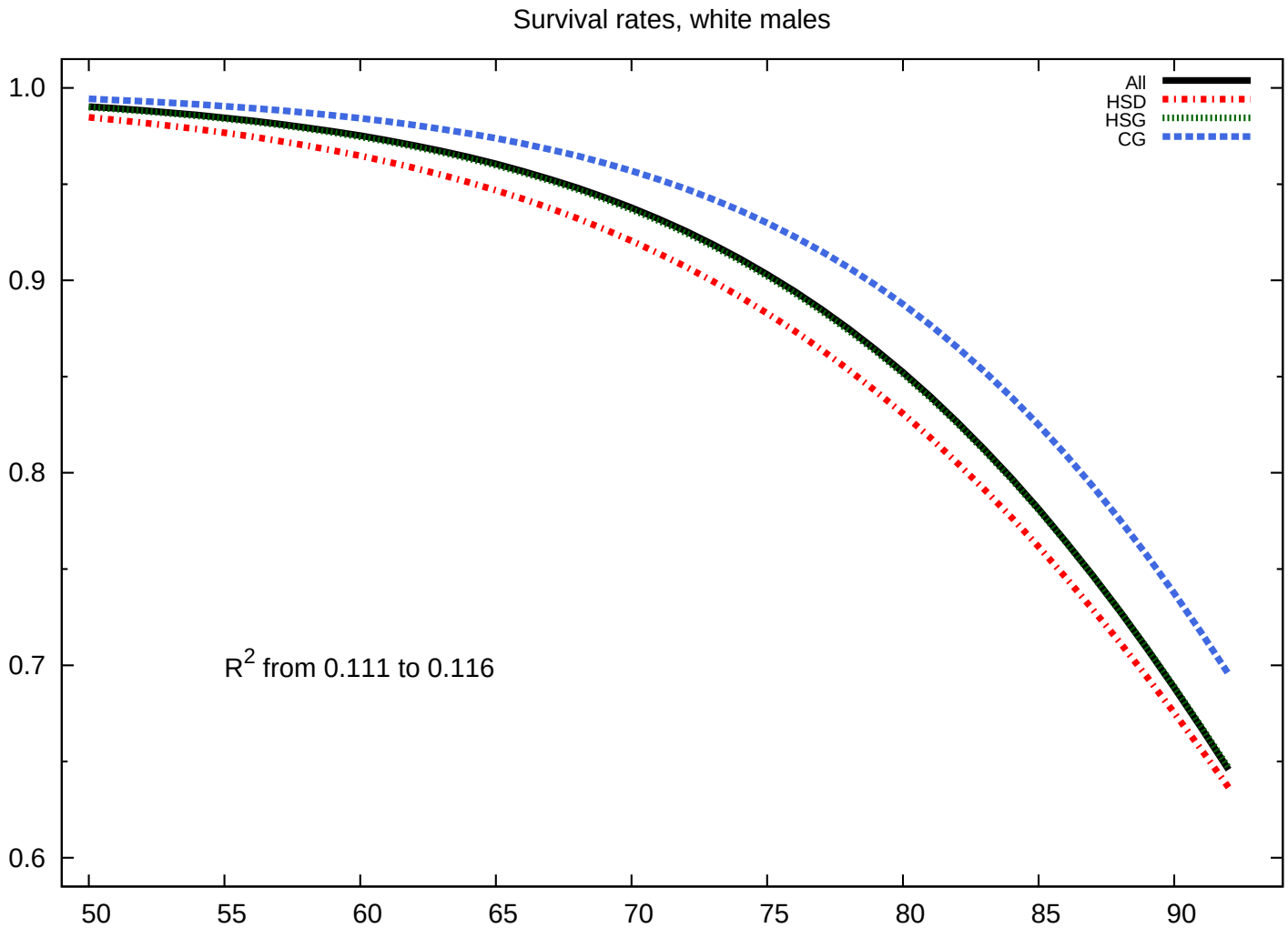
2) Survival increases between (self-assessed) **health** groups

   - within health groups, survival **does not** change with assets
   - sample of non-retired: survival increases with earnings

     (but barely significant)

Survival probabilities

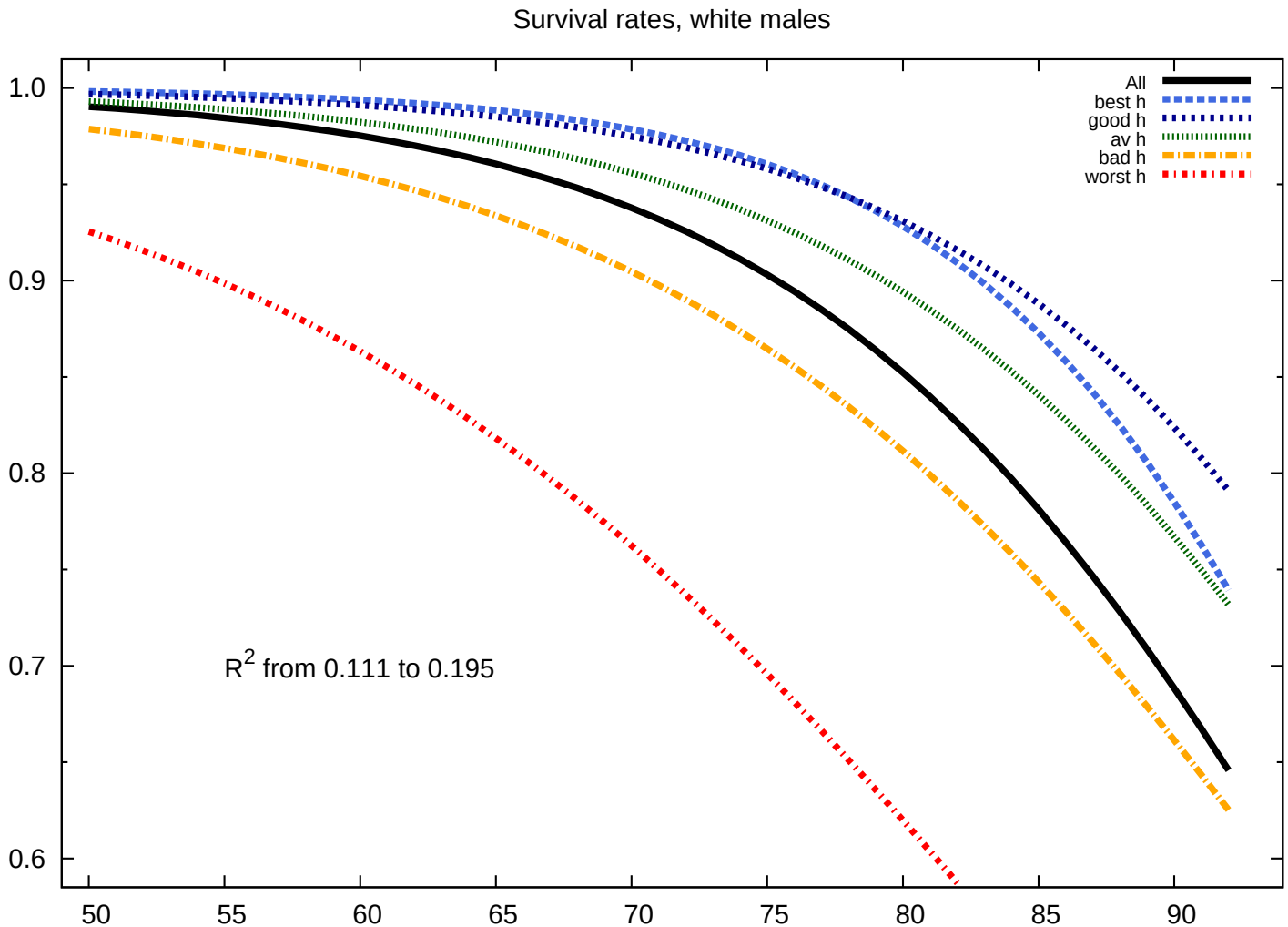
Survival by education groups



Source: HRS

Survival probabilities

Survival by health groups



Source: HRS

Survival probabilities

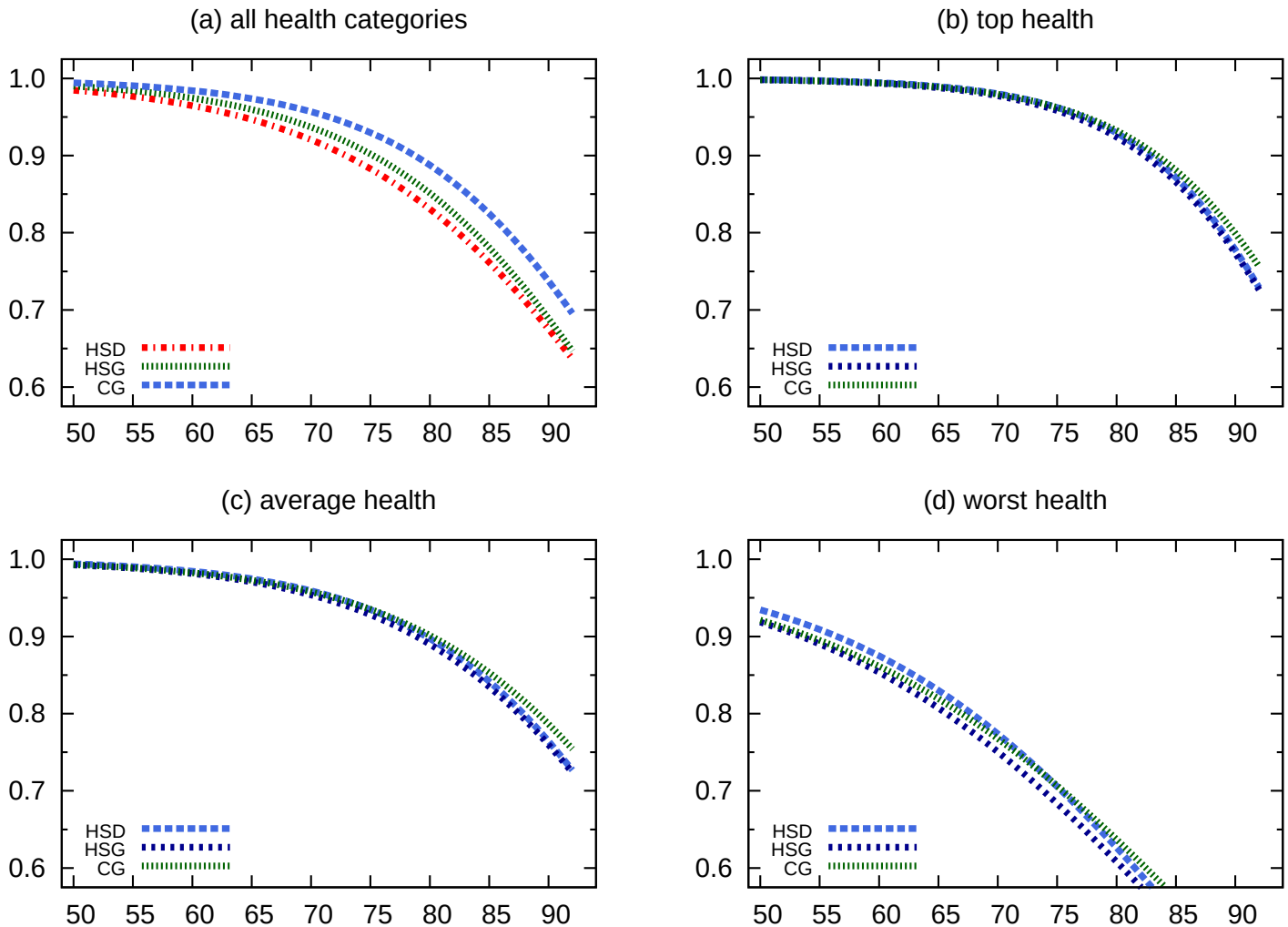
Health and education

3) Conditional on **health** and **education**: only health seems to matter

   - Education non-significant in logit regression

Survival probabilities

Survival by health and education groups



Source: HRS

Life Expectancies at 50

How to build them

1. Initial health distribution by education e. $x_{50}^{e,h}$.
2. Education specific health transitions. $p_i^e(h'|h)$.
3. Education and Health specific Survival Rates. $\gamma_i^{e,h}$.
4. Then,

$$\begin{aligned} \ell^e &= \sum_{i=51}^{99} i \sum_{h \in H} \left(1 - \gamma_i^{e,h}\right) x_i^{e,h} \\ x_{i+1}^{e,h'} &= \sum_{h} p_i^e(h'|h) \ \gamma_i^{e,h} \ x_i^{e,h} \end{aligned}$$

Life Expectancies at 50

Results

Life expectancies

	All	HSD	HSG	CG	gap
male	77.4	74.2	76.8	80.1	**5.8**
female	81.2	77.6	81.2	83.5	**5.9**

Life Expectancies at 50

We can mechanically decompose these effects

- Is it education specific mortality?

  $\{x_{50}^{h}, \quad p_i(h'|h), \quad \gamma_i^{e,h}\}.$

- Is it education specific health evolution?

  $\{x_{50}^{h}, \quad p_i^{e}(h'|h), \quad \gamma_i^{h}\}.$

- Is it initial health?

  $\{x_{50}^{e,h}, \quad p_i(h'|h), \quad \gamma_i^{h}\}.$

Life Expectancies at 50

Descomposition results

Life expectancy premium: CG-HSD

	male	female
Overall	**5.8**	**5.9**
(a) Edu-specific mortality	**-0.3**	**0.4**
(b) Edu-specific transition	**4.7**	**4.9**
(c) Edu-specific initial health	**1.7**	**1.1**

- It is one third initial health and two thirds health transitions.

- It seems that the late health management does not matter that much.

- This is not to say that health care differences do not matter as many problems last a long time.

Do other obvious things matter? Smoking, Marital status?

1. Initial health distribution by education e and marital. $x_{50}^{e,m,h}$.
2. Education specific health-marital transitions. $p_i^e(h', m'|h, m)$.
3. Education, Marital and Health specific Survival Rates. $\gamma_i^{e,m,h}$.
4. Then,

$$\ell^{e,m} = \sum_{i=51}^{99} i \sum_{h \in H} \left(1 - \gamma_i^{e,m,h}\right) x_i^{e,m,h}$$

$$x_{i+1}^{e,m',h'} = \sum_{h} p_i^e(h', m'|h, m) \ \gamma_i^{e,m,h} \ x_i^{e,m,h}$$

Do other obvious things matter? Smoking, Marital status?

▷ Look at education and marital status at age 50

Life expectancies by education and marital type

	All	HSD		HSG		CG		gap	(a)	(b)	(c)
		m	nm	m	nm	m	nm				
male	77.4	74.4	**72.2**	77.0	74.3	**80.2**	78.5	**7.9**	0.9	5.6	1.9
female	81.2	77.8	**76.3**	81.4	80.1	**83.7**	82.9	**7.4**	0.6	5.5	1.6

▷ Look at education and smoking status at age 50

Life expectancies by education and smoking type

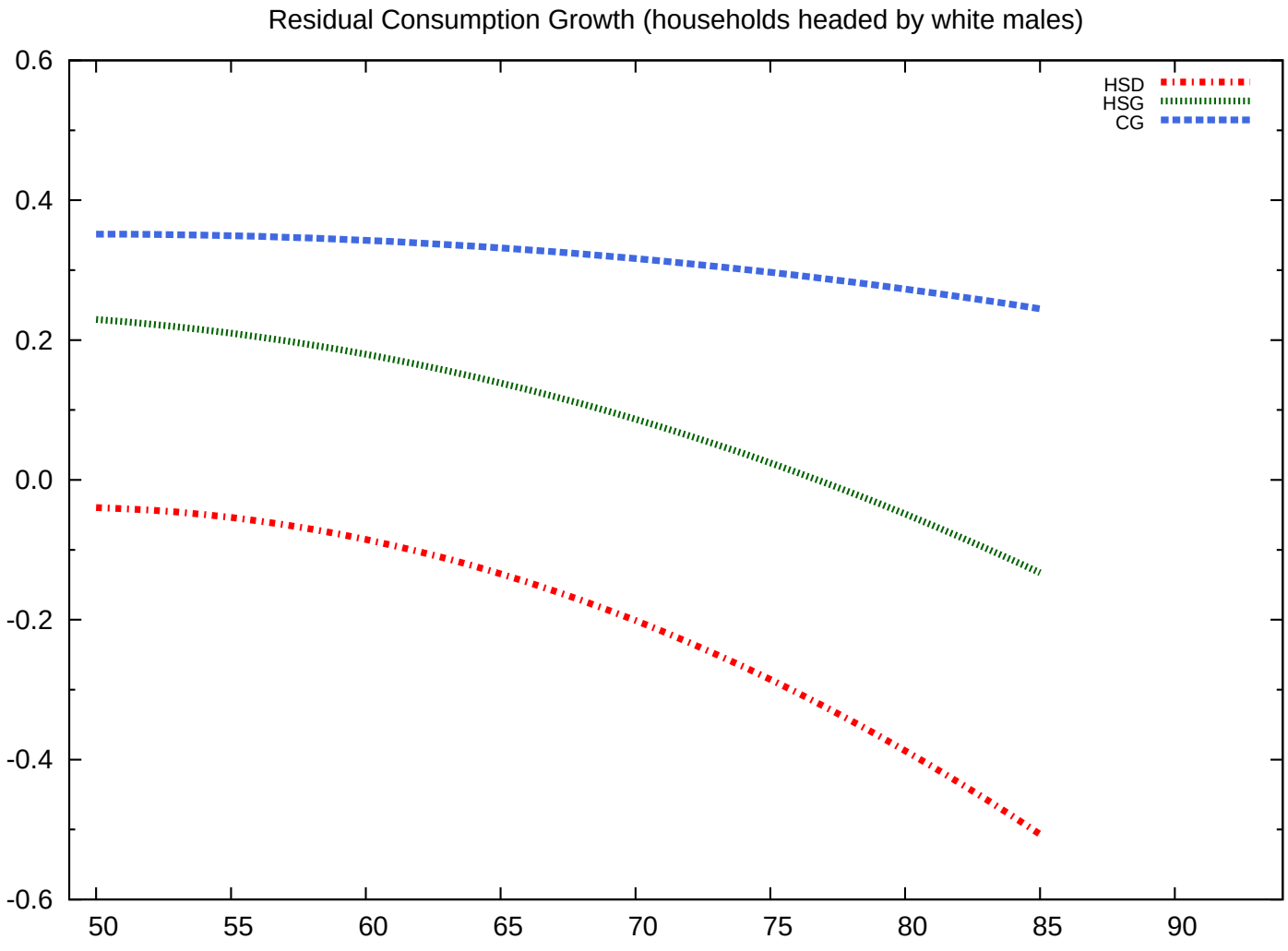
	All	HSD		HSG		CG		gap	(a)	(b)	(c)
		ns	s	ns	s	ns	s				
male	77.5	75.3	**73.0**	77.7	75.3	**80.6**	77.5	**7.5**	0.3	5.5	1.9
female	81.3	78.2	**76.5**	81.9	79.8	**83.8**	82.5	**7.2**	1.0	5.4	1.1

We observe directly some actual health investment actions

- Investments are bigger for the well to do.
  - Cholesterol tests, flu shots, prostate tests, non smoking increase with education and with marriage.
  - Investments are also increassing in wealth and insurance coverage.
  - Mixed bag about health. Prostate tests are neutral. Cholesterol and flu shots decrease with health.
- Investments, however, do not improve transitions. In fact, flu shots, and cholesterol worsens them. (Mammograms and cervical cancer tests improve transition for women).
  - Insufficient measure of investment.
  - Health measured with error?
  - Some of those medical actions are not investment but maintenance.

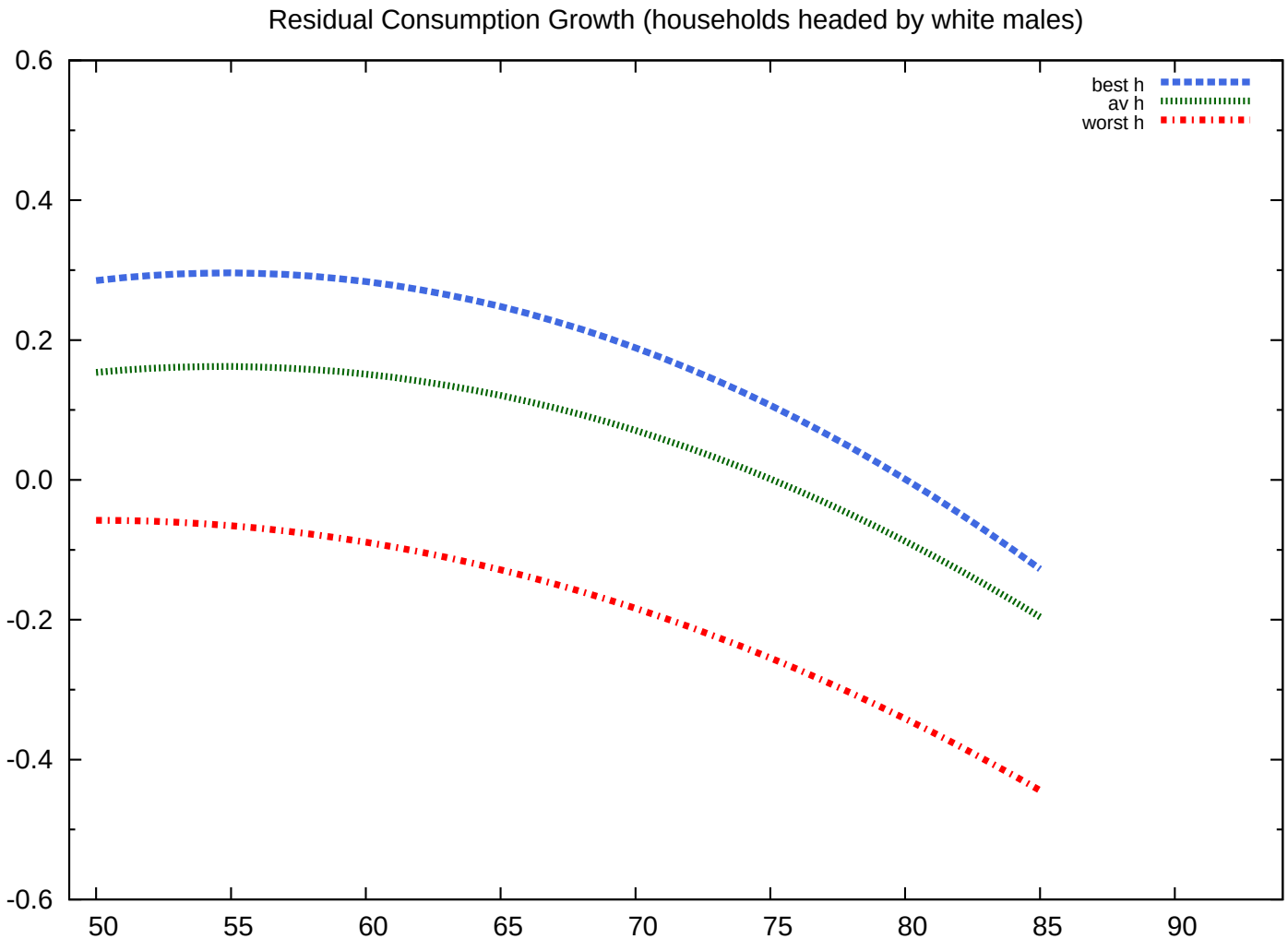
What about other investments? Savings.

By education group. Source: PSID + CEX Consumption Imputation



What about other investments? Savings.

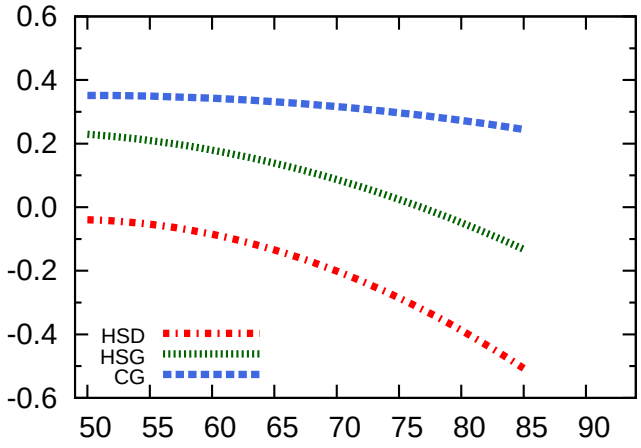
By health group



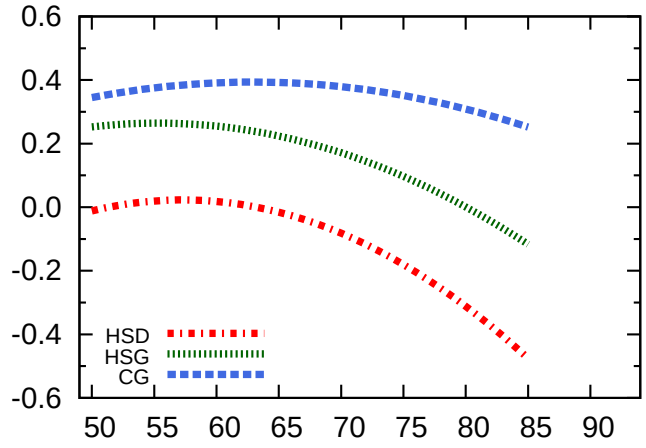
In this case it is education not health what matters.

Consumption growth by education and health groups

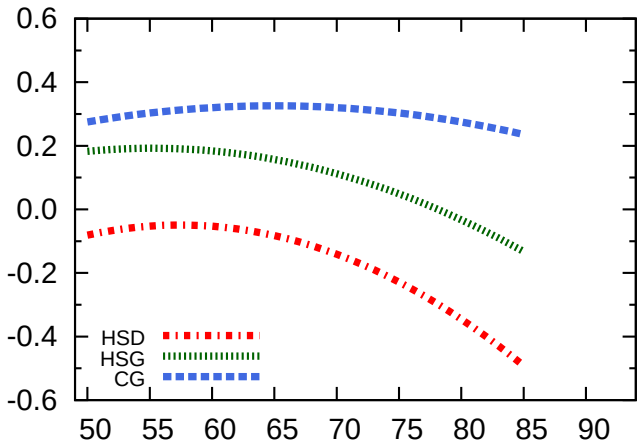
(a) all health categories



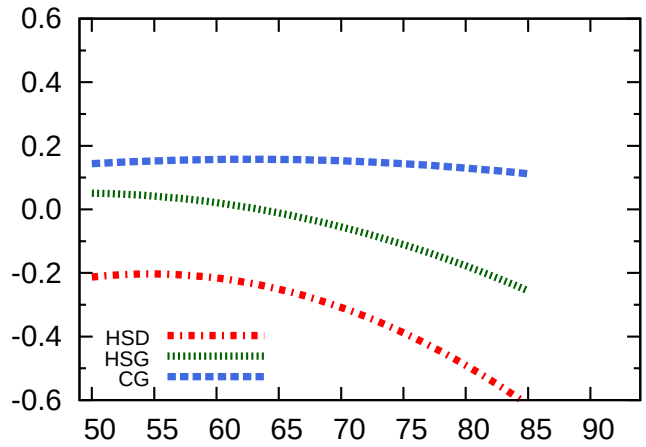
(b) top health



(c) average health



(d) worst health



Data Conclusions

i. **Self-assessed health and education** are very good predictors of *mortality*.

ii. **Transitions** are what matter.

iii. **Health investments** increase with wealth and education. Poor effects on transitions.
   a. *Non-smoking* is the only clear investment.
   b. *Cholesterol tests* and *flu shots* worsen transition.

iv. **Consumption growth** (not only patience, survival probabilities matter) is associated to *education* and *health*.

Part II

Main Question

Where is the advantage from education coming from?

- Patience or some other preference attribute.
- More resources (money, spouses)?
- Lower costs of undertaking health investments.
- Intrinsically better built.

- Need **a model** to tease this mechanisms out.

Part III

Theory

Elements of the model

- Human capital investment model, with various types of actions:
  - Savings
  - Health care investments
    (including efforts to quit smoking/to remain married).
  - Health maintenance.
  - Education choice in an earlier period.

The model

Exogenous state variables

- There may or may not be individual fixed heterogeneity,
  - Ability η
  - Patience β
  - Taste for health-related behavior α

  Let $\tau = \{\eta, \beta, \alpha\}$ denote the types.

- These variables may induce differential behavior in each state.

The model Endogenous state variables

- Age. It is endogenous in this project.
- Education $e \in E$. Discrete.
  - Education leads to higher labor earnings.
  - Education may lead to longer lived partner and better health transition.
- Health $h \in H$. Discrete. It may include marital/smoking status.
  - Health improves survival odds, γ^{ih}
  - Choice of health investment y drives markov chain $p_i\left(h'|h,y\right)$
  - Marriage and non smoking improve health transition and require efforts. (except for survival of spouse).
- Wealth $a \in A$. Discrete.
  - Standard budget constraint.

The model

Shocks

- Death. γ^{ih}.
- Health evolves stochastically. For now it only depends on age and investment. $p^i(h'|h, y)$.
- Earnings, ϵ. Markovian conditional on age and education. $F^{ie}(\epsilon'|\epsilon, h')$.

The model

Periods and decisons

- Individuals live for a maximum of I periods.
- Individuals choose
  - education effort x in first period
  - consumption c and health investment y in all periods
- Within period utility function:

$$u^{\alpha}(h, c, y, m) = \bar{u} + \frac{c^{1-\sigma}}{1-\sigma} - \alpha \frac{y^{1+\nu}}{1+\nu} - \psi(h, m) \qquad \sigma, \nu, \alpha, \bar{u} > 0$$

- $\psi(h, m)$: health maintenance alleviates. Still have to be developed.

The model

Optimization problem

$$V_i^{\tau,e}(\epsilon, h, a) = \max_{c,y,a',m} \Big\{ u^{\alpha}(h, c, y, m) + \beta\gamma^{ih} \sum_{h',\epsilon'} p^i\left(h'|h, y\right) \; F^{ie}(\epsilon'|\epsilon, h') \; V_{i+1}^{\tau,e}\left(\epsilon', h', a'\right) \Big\}$$

$$\text{with} \qquad c + m + a' = R\, a + w\, \epsilon$$

- Agent's problem at $i = 0$, is to place effort to become educated. Better types put more effort.

The model

The consumption Euler equations

- The consumption Euler equation is standard,

$$u_c^{\alpha}(h, c, y, m) = R\,\beta\,\gamma^{ih} \sum_{h',\epsilon,} p^{i}\left(h'|h, y\right)\; F^{ie}(\epsilon'|\epsilon, h')\; u_c^{\alpha}\left(h', c', y', m'\right)$$

- There is a static Euler equation between consumption and maintenance.

$$u_c^{\alpha}(h, c, y, m) = u_m^{\alpha}(h, c, y, m)$$

The model

The health-behavior FOC

$$-u_y^{\alpha}\left(h,c,y,m\right)=\beta\gamma^{ih}\sum_{h',\epsilon'}\frac{\partial p^{i}\left(h'|h,y\right)}{\partial y}\;\;F^{e}(\epsilon'|\epsilon,h')\;\;V_{i+1}^{\tau,e}\left(\epsilon',h',a'\right)$$

- Health investment y increases if
  - The discount factor is larger: higher β and γ^{ih}
  - The expected value function tomorrow is larger: higher, e, a, ϵ, h
  - The cost of health investment is lower: lower α

Part IV

Identification and (Indirect) Estimation

Statistics to target

- Some objects can be estimated outside the model:
  - Earnings processes.
- The main targets are the the age and education specific
  - Health (including marital status and smoking) Transitions.
  - Survival rates.
  - Consumption growth rates.
- There is need for other statistics associated to individual change.
  - Change in health actions or investments upon health decay.
  - Change in savings upon health decay.

Hope to have some results next time

Conclusions

- There are large differences in education specific life expectancy.
- These are associated to health as measured via self assessment.
- What matters is the health to health transition to which non-smoking and marriage contributes.
- To identify the root of the advantages of education, we need to estimate rich models.
- We have some ideas of the ingredients of these models, but we have a long way to go before we can estimate them.