

# Healthy Habits and Inequality

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Preliminary

# Introduction

- In recent decades, there has been an increase in inequalities  
(*wealth, consumption, income, health outcomes*)
- Two important facts:
  - a) Strong connection between economic and health inequality  
*Kitagawa and Hauser (1973); Pijoan-Mas and Rios-Rull (2014); Chetty et al (2016)*
  - b) Growing educational gradients of health inequality  
*Preston and Elo (1995); Meara et al. (2009); Montez et al (2011); Case and Deaton (2015)*

→ Reasons not well-understood
- We aim to study to which extent differences in lifestyles across education groups and time can account for these facts
  - More educated individuals tend to adopt healthier habits → health inequality  
*Lantz (1998); Martikainen et al. (2013)*

# Objectives

- ① Measure the impact of different lifestyles on **health dynamics** and **economic outcomes**
- ② Understand the joint determination of education and lifestyle
- ③ Quantify the effect of increased economic inequality on the increase in inequality of health outcomes

## What we do: Data

- There are many indicators of health behavior in HRS and PSID  
(*preventive tests, substance abuse, exercise*)
- Ideally, we would like to incorporate all this info into a structural model
- Problems:
  - Indicators imperfectly correlated across individuals and over time
  - Curse of dimensionality
- [Contribution](#) → Novel methodology to reduce the dimensionality of the data by identifying (permanent) patterns in lifestyle behavior exploiting:
  - Cross-sectional and panel variation on health behavior
  - Relationship between health behavior and health dynamics

# What we do: Data

## Results

- ① Health behavior is parsimoniously well represented by two different lifestyles: **protective** and **detrimental**
- ② Large LE gradient at age 50: 8 years between **protective** and **detrimental**
- ③ Lifestyles are correlated w/ education
  - **Harmful** types much more frequent among the less educated
  - Habit gradient of similar size within education groups
  - Lifestyles explain around 40% of the education gradient in LE
- ④ Individuals holding **detrimental** health behaviors accumulate less wealth (controlling by education)
- ⑤ There is an increasing dispersion in lifestyles across education groups
  - Lifestyles explain 1/3 of the LE edu gradient for individuals born in the 1930s
  - Lifestyles explain 1/2 of the LE edu gradient for individuals born in the 1970s

# What we do: Model

## *Main ingredients*

- We build an heterogeneous agents model featuring two different stages
  - ① Early life: individuals choose education and lifestyle.
  - ② Working/retirement age: individuals solve a standard life-cycle model with idiosyncratic labor income and health risks  
(conditional on given education and lifestyle)
- Complementarities between education and lifestyle investments
  - An extra year of life is more valuable with higher consumption possibilities
  - Bad health harms labor earnings differently across education groups
  - The benefit in health transitions of investing in **protective** health behavior differs across education groups

# What we do: Model

## *Numbers*

- We take health dynamics conditional on education and lifestyle as given
- Calibrate the model to match:
  - ① The joint distribution of education and lifestyles choices for different cohorts: born in the 30's, 50's and 70's.
  - ② Savings decisions by education and lifestyles of individuals born in 1930's.
- Main results:
  - The most important driver of the education gradient of lifestyles is the income gradient of education
  - The increases in income inequality between the cohorts born in 1930s and 1970s explains around 78% of the increase in LE gradient (through the increase in the lifestyle gradient)

# Literature on health and economic inequality

- Models with *exogenous health*

De Nardi et al. (2023); Hosseini et al. (2021)

→ We model endogenous health

- Models with *endogenous monetary health investments*

Fonseca et al. (2023); Hong et al.(2023)

→ We focus on health-related behaviour

- Models with *endogenous health behaviour investments*

Cole et al. (2019); Mahler and Yum (2023); Margaritis and Wallenius (2023)

→ We focus on once-and-for-all choices of lifestyles and education

→ Identification of lifestyles on health based on differences in health dynamics and mortality.

→ We study how changes in economic inequality shape health inequality





# The Data

- The HRS and PSID provide an unbalanced panel of individuals  $i = 1, \dots, N$  followed for  $t = 1, \dots, T$  periods
- Standard demographic information: gender ( $g$ ), education ( $e$ ), age ( $a_t$ )
- Wide array of information on **health status** and **health behavior**
  - Health state ( $h_t$ ): self-reported health (good/bad) + death
  - Health behavior ( $z_{mt}$ ):
    - 1 Preventive cancer tests (mammography / prostate check)
    - 2 Cholesterol test
    - 3 Flu shot
    - 4 Heavy drinking (2+ drinks on the day they drink)
    - 5 Smoking
    - 6 Exercise

## Latent types

- We want to incorporate heterogeneity in health dynamics across lifestyles into a structural model.
- In principle, we could include all the health behavior variables into the state-space but that would imply:  $2^6$  grid points for describing it.
- Instead, we are going to assume that observed health behavior ( $z_{mt}$ ) is the result of some **latent time-invariant** factor ( $y$ )
  - The latent factor is represented by a few discrete groups  $y \in \{y_1, y_2, \dots\}$ .
- We interpret the latent factor ( $y$ ) as the lifestyle
  - Allocate individuals to lifestyles
  - Measure the importance of lifestyles on health dynamics

# Econometric Model

## Overview

- We *jointly estimate* health dynamics and lifestyles using a mixture model:

$$\begin{aligned} p(\mathbf{z}, \mathbf{h} | c, s, e, a, h_0) &= \sum_{y \in Y} p(\mathbf{z}, \mathbf{h} | c, s, e, a, h_0, y) p(y | c, s, e, a, h_0) \\ &= \sum_{y \in Y} p(\mathbf{z} | \mathbf{h}, a, h_0, y) p(\mathbf{h} | s, e, a, h_0, y) p(y | c, s, e, a, h_0) \end{aligned}$$

- By estimating types and transition jointly, we find the types that better represent both the observed behaviour and the health transitions  
(vs. k-means clustering on habits and then transitions)
- Conditional on the lifestyle ( $y$ )
  - Health behaviours ( $z_{mt}$ ) are iid, modelled through a probit
  - Health outcomes ( $h_t$ ) are first-order markovian, modelled through a multinomial probit

# Econometric Model

## 1. Healthy Habits

- We model the probability of individual  $i$  of reporting the  $m$ 'th behaviour ( $z_{mt} = 1$ ) at time  $t$  as a probit model.

- There is a latent variable ( $z_{mt}^*$ ) that depends on type ( $y$ ), age ( $a_t$ ), health ( $h_t$ ), and an idiosyncratic shock ( $\epsilon_t$ )

$$z_{mt}^* = \gamma_{0,m,y} + \gamma_{1,m,y}a_t + \gamma_{2,m,y}a_t^2 + \gamma_{3,m,y}h_t + \epsilon_t, \quad \epsilon_t \sim N(0, 1)$$

- Then,

$$\text{Prob}(z_{mt} = 1) = \text{Prob}(z_{mt}^* > 0) = \underbrace{\alpha_m(y, a_t, h_t)}_{\alpha_{mt}}$$

- Considering independence of health behaviour given type, the probability of observing a sequence of health behaviours  $z$  for an individual across time, is assumed to be given by:

$$p(z|h, y) = \prod_{t=1}^T \prod_{m=1}^M \alpha_{mt}^{z_{mt}} (1 - \alpha_{mt})^{1-z_{mt}}$$

# Econometric Model

## 2. Health Dynamics

- We model the probability of reporting some health  $h' \in \{Good, Bad, Dead\}$  next period as a [multinomial probit model](#)
  - There are latent variables ( $h_{h,h'}^*$ ) that depend on gender ( $g$ ), education ( $e$ ), type ( $y$ ), health ( $h$ ), age ( $a$ ), and an idiosyncratic shock ( $\epsilon_{h'}$ )

$$h_{h,h'}^* = f(a, s, e, y; \beta_{h,h'}) + \epsilon_{h'}$$

with,

$$f(a, g, e, y; \beta_{h'}) = \beta_{0,y,e,g,h,h'} + \beta_{1,y,e,g,h,h'} a$$

# Econometric Model

## 3. Weights

- The mixture weights at the initial age (age 25) are modeled as a multinomial probit model:

$$\begin{aligned} y_1^* &= \lambda_{0,s,e,c}^1 + \lambda_{1,s,e}^1 bh + \epsilon_1 \\ &\vdots \\ y_Y^* &= \lambda_{0,s,e,c}^Y + \lambda_{1,s,e}^Y bh + \epsilon_Y, \end{aligned}$$

- We compute weights for future ages using the health transition model:

$$p(y, h_t | s, e, c) = \sum_{h_{t-1}} p(h_t | h_{t-1}, y, s, e) p(y, h_{t-1} | s, e, c)$$

## Results: Lifestyles

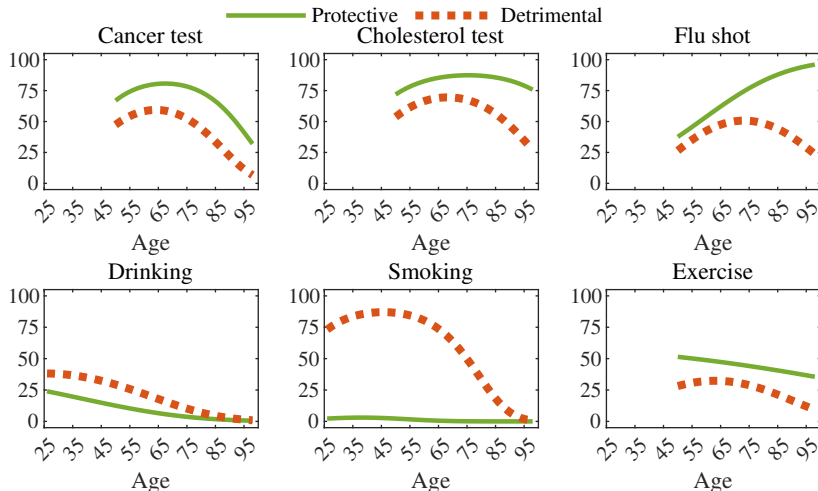


Figure: Probability of reporting health behaviors by lifestyle



# Results: Lifestyles, education, and health dynamics

## Males

**Table:** LE at age 50 across education and lifestyles: males born in 1950s

	Dropouts		High-school		College		College-Dropout	
	Share	LE	Share	LE	Share	LE	$\Delta$ LE	$\Delta$ LE
All	100.0	25.5	100.0	28.0	100.0	32.3	6.8	4.3
Protective	54.3	29.0	69.1	30.3	88.3	33.4	4.4	
Detrimental	45.7	21.4	30.9	23.0	11.8	24.5	3.1	
$\Delta$	8.6	7.6	38.2	7.2	76.5	8.9	1.4	

# Results: Lifestyles, education, and health dynamics

## Females

**Table:** LE at age 50 across education and lifestyles: females born in 1950s

	Dropouts		High-school		College		College-Dropout	
	Share	LE	Share	LE	Share	LE	$\Delta$ LE	$\Delta$ LE
All	100.0	28.1	100.0	31.5	100.0	34.3	6.2	4.6
Protective	68.5	30.3	75.9	33.2	90.0	34.9	4.6	
Detrimental	31.5	23.2	24.2	26.1	10.0	28.2	5.0	
$\Delta$	37.0	7.1	51.7	7.2	80.1	6.7	-0.4	

## Results: Health Dynamics

- More educated individuals tend to adopt healthier lifestyles.
  - The fraction of males with harmful lifestyle is 4 times bigger among high-school dropouts than among college graduates.
- If dropout males had the same lifestyles as college males, their life expectancy would increase by 2.5 extra years.
  - This corresponds to 37% of the observed difference in life-expectancy.

## Results: Changes across cohorts

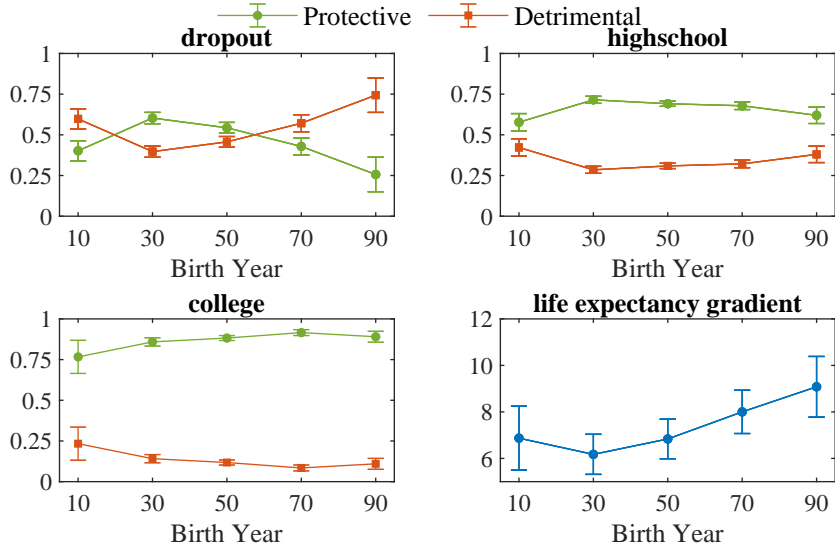


Figure: Probability of lifestyle at age 50 across cohorts. Males.

## Results: Changes across cohorts

- Differences in lifestyles across education groups have increased.
  - The share of dropouts holding a detrimental lifestyle has increased from 40% for those born in 1930 to 57% for those born in 1970.
  - The share of college graduates holding a detrimental lifestyle has decreased from 14% for those born in 1930 to 8.4% for those born in 1990.
- This divergence in lifestyles across education groups has led to an increase in the life expectancy gradient.
  - From 6.2 years in 1950 to 8.0 years in 1970.
  - The importance of the differences in lifestyles to explain the life expectancy gradient has increased from 31% to 46% for those born in 1930 and 1970, respectively.



# The Model

## *Two different stages*

### ① Early life

- Choice of education and lifestyle

### ② Life cycle

- a) Working age: standard life-cycle incomplete-markets model of consumption with health and labor market risks
- b) Retirement: as before, but without labor market risks





# State variables

- Working agents are heterogeneous with respect to:

## ① Types

- Education  $e \in \{\text{HSD}, \text{HSG}, \text{CG}\}$
- Lifestyle  $y \in \{\text{DET}, \text{PRO}\}$
- Cohort  $c \in \{1930, 1950, 1970\}$

## ② Exogenous and deterministic state

- Age  $t \in \{25, 27, 29, \dots\}$

## ③ Exogenous and stochastic states

- Health status  $h_t \in \{h_g, h_b\}$
- Shock to earnings  $\zeta_t \in \mathbb{R}$
- Shock to medical expenses  $\xi_t \in \mathbb{R}$

## ④ Endogenous state

- Cash-on-hand  $x_t \in [\underline{x}, \infty)$

## Important ingredients

- Health dynamics  $s_t^{\text{ey}}(h)$  and  $\Gamma_t^{\text{ey}}(h'|h)$  as estimated before
  - Survival and health transition are *not* cohort-specific  
(*cohort effects appear through the joint distribution of  $e$  and  $y$* )
- Medical expenses  $m_t(\xi, h)$
- Labor earnings  $w_t^{\text{ec}}(\zeta, \epsilon, h)$  depend on
  - Education  $e$ , cohort  $c$ , and age  $t$
  - Persistent and transitory stochastic component  $\zeta$  and  $\epsilon$
  - Health  $h$
- Education costs  $\bar{\tau}_t^{\text{ec}}$  paid over 8 first years of working life
- Progressive tax system  $T()$  and minimum income floor  $\underline{x}$

## Worker's problem

- Worker's problem can be written as:

$$V_t^{\text{eyc}}(h, \xi, \zeta, x) = \max_{c, k'} \left\{ u(c) + \beta s_t^{\text{ey}}(h) \sum_{h'} \Gamma_t^{\text{ey}}(h'|h) \mathbb{E}[V_{t+1}^{\text{eyc}}(h', \xi', \zeta', x')] \right. \\ \left. + \beta^{T-t} (1 - s_t^{\text{ey}}(h)) v(k') \right\}$$

s.t.

$$k' = x - c$$

$$\tilde{x}' = (1 + r) k' + w_t^{\text{ec}}(\zeta', \epsilon', h') - m_t(\xi', h') - \bar{\tau}_t^{\text{ec}} - T[w_t^{\text{ec}}(\zeta', \epsilon', h')]$$

$$x' = \min \{ \tilde{x}', \underline{x} \}$$

$$\text{Flow utility: } u(c) = \frac{c^{1-\sigma}}{1-\sigma} + b$$

$$\text{Bequest motive: } v(k) = \theta_1 \frac{(k + \theta_2)^{1-\sigma}}{1-\sigma}$$

# Estimation

## *A two-step estimation strategy*

- ① External: parameters related to demographics, taxes, social security, and the stochastic processes for earnings and for health dynamics
  - This includes cohort-specific wages  $w_t^{\text{ec}}(\zeta, h, \epsilon)$  and education costs  $\bar{\tau}_t^{\text{ec}}$
- ② Internal: SMM to calibrate remaining parameters
  - Median wealth across age (by education and lifestyles) for the 1930s cohort
  - Value of statistical life

# Estimation

## *Externally estimated parameters*

- Labor income:

- Extensive margin: participate ( $l_t = 1$ ) or not ( $l_t = 0$ ).

$$l_t^* = f(t, e_t, h_t, l_{t-1}) + \epsilon, \epsilon \sim N(0, 1)$$

$$l = 1 \text{ if } l^* > 0$$

- Intensive margin:

$$w_t^{\text{ec}}(\zeta, \epsilon, h) = \omega_t^{\text{ec}}(h_t) + \zeta_t + \epsilon_t, \epsilon_t \sim (0, \sigma_\epsilon^2)$$

$$\zeta_t = \rho_\zeta \zeta_{t-1} + \nu_t, \nu_t \sim N(0, \sigma_\nu^2)$$

- Medical expenses

$$m_t(\xi, h) = \lambda_t^e(h_t) + \xi_t$$

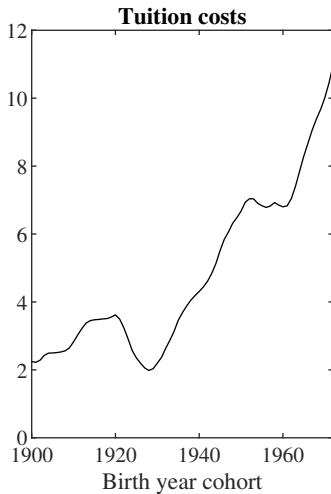
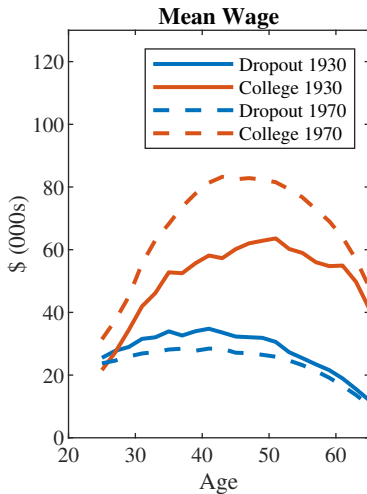
$$\xi_t = \rho_\xi + \psi, \psi \sim N(0, \sigma_\psi^2)$$

- Tuition fees

$$\bar{\tau}_t^{\text{ec}}$$

# Estimation

## Externally estimated parameters



# Estimation

## *Internally estimated parameters*

- The model is able to replicate
  - Higher wealth accumulation for the more educated
  - Higher wealth accumulation for the **protective** (conditional on education)
- Parameter values

Parameter	Description	Value
$\underline{x}$	income floor	16.05
$\theta_1$	bequest motive: marginal utility	9.57
$\theta_2$	bequest motive: non-homoteticity	130.36
$b$	value of life	0.66

# Estimation

## Model Fit

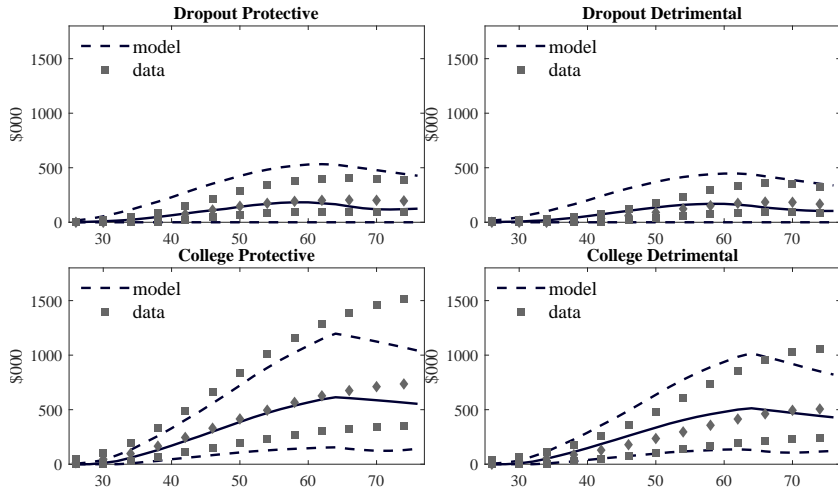


Figure: Wealth distribution: model vs data





## Set up

- Teenager/parents make once-and-for-all simultaneous choices of
  - education  $e \in \{\text{HSD}, \text{HSG}, \text{CG}\}$
  - lifestyle  $y \in \{\text{DET}, \text{PRO}\}$

- They solve  $\max_{e,y} \left\{ V_0^{\text{eyc}} - \tau_{ec} - \tau_{yc} \right\}$

- Value  $V_0^{\text{eyc}}$  of starting stage 2 with type  $(e, y, c)$
- Cost  $\tau_{ec}$  of education  $e$  for cohort  $c$ :

$$\tau_{\text{HSD},c} = 0 \quad | \quad \tau_{\text{HSG},c} = \mu_{\text{HSG}} + \epsilon_{\text{HSG},c} \quad | \quad \tau_{\text{CG},c} = \mu_{\text{CG}} + \epsilon_{\text{CG},c}$$

- Cost  $\tau_{yc}$  of lifestyle  $y$  for cohort  $c$ :

$$\tau_{\text{DET},c} = 0 \quad | \quad \tau_{\text{PRO},c} = \mu_{\text{PRO}} + \epsilon_{\text{PRO},c}$$

- Where  $\mu_e, \mu_y$  are average costs of actions  $e$  and  $y$
- Where  $\epsilon_{e,c}, \epsilon_{y,c}$  are (jointly distributed) idiosyncratic costs of actions  $e$  and  $y$

## Shocks

- Let  $(\epsilon_{\text{PRO},c}, \epsilon_{\text{HSG},c}, \epsilon_{\text{CG},c})$  be joint normally distributed:

$$\begin{bmatrix} \epsilon_{\text{PRO},c} \\ \epsilon_{\text{HSG},c} \\ \epsilon_{\text{CG},c} \end{bmatrix} \sim N \left( \begin{bmatrix} 0 \\ 0 \\ 0 \end{bmatrix}, \begin{bmatrix} \sigma_{\text{PRO}}^2 & \sigma_{\text{PRO,HSG},c} & \sigma_{\text{PRO,CG},c} \\ & \sigma_{\text{HSG}}^2 & \sigma_{\text{CG,HSG}} \\ & & \sigma_{\text{CG}}^2 \end{bmatrix} \right)$$

where

$$\begin{aligned} \sigma_{\text{PRO},e,c} &= \rho_{\text{PRO},e}^c \sigma_{\text{PRO}} \sigma_e \\ \sigma_{\text{CG,HSG}} &= \rho_{\text{CG,HSG}} \sigma_{\text{CG}} \sigma_{\text{HSG}} \end{aligned}$$

- $\rho_{\text{PRO},e}^c$  captures complementarities in education and health investments beyond the ones incorporated in the 2nd stage of the model (genes, parents, friends, neighborhood, etc.)
  - $\rho_{\text{CG,HSG}}$  captures complementarities in the different education choices
- Note that only  $\rho_{\text{PRO},e}^c$  is cohort-specific

# Calibration

- Match the joint distribution of  $e$  and  $y$  in each cohort  $c$ 
  - A total of 13 parameters and 15 statistics
- Identification
  - $\mu_e, \mu_y$  drive the average share of  $e$  and  $y$  over time
  - $\sigma_e^2, \sigma_y^2, \rho_{CG,HSG}$  drive changes in  $e$  and  $y$  over cohorts  $c$  as  $V_0^{eyc}$  changes (due to changes in wages and tuition fees)
  - $\rho_{PRO,e}^c$  residually matches the joint distribution of  $e$  and  $y$  in each cohort  $c$

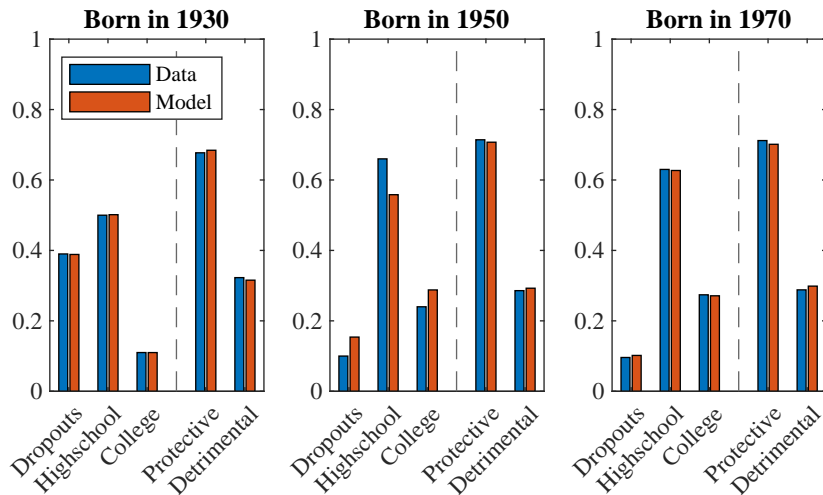
# Calibration

## Parameters

Parameter	Value	Parameter	Value	Parameter	Value
$\mu_{\text{PRO}}$	11.3	$\rho_{\text{PRO,HS}}^{1930}$	0.02	$\rho_{\text{PRO,COL}}^{1930}$	0.01
$\mu_{\text{HSG}}$	8.9	$\rho_{\text{PRO,HS}}^{1950}$	0.02	$\rho_{\text{PRO,COL}}^{1950}$	0.01
$\mu_{\text{CG}}$	35.7	$\rho_{\text{PRO,HS}}^{1970}$	0.04	$\rho_{\text{PRO,COL}}^{1970}$	0.13
$\sigma_{\text{PRO}}$	10.6				
$\sigma_{\text{HSG}}$	1.6				
$\sigma_{\text{CG}}$	14.6				
$\rho_{\text{HS,COL}}$	0.0				

# Calibration

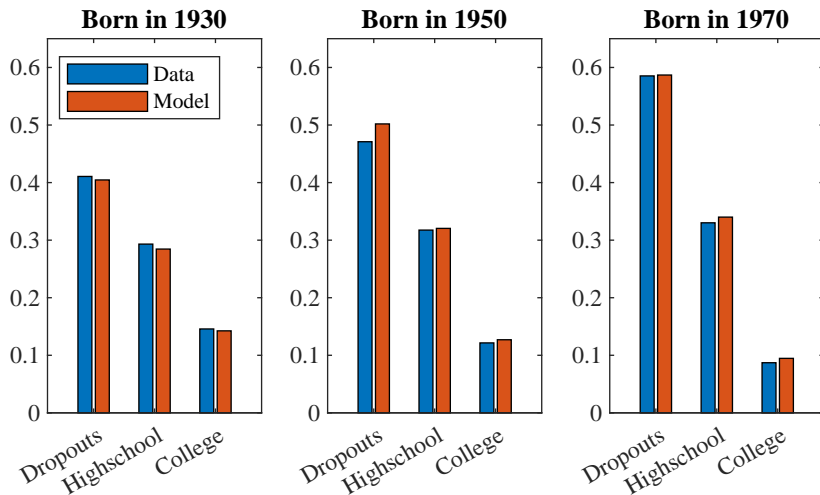
*Fit: marginal distributions*



**Figure:** Marginal distributions: Education and Health Behavior

# Calibration

*Fit: conditional distributions*



**Figure:** Conditional distribution of Detrimental Behavior by Education





## Two questions

- 1 Why do individuals with higher education opt for more protective health behaviors?
- 2 To what extent the rise in earnings inequality has led to increased health inequalities?



# Mechanisms

- Our model incorporates various mechanisms through which the incentive to adopt a given health behavior varies across educational choices:

① Income gradient:  $w_t^{\text{ec}}(\zeta, \epsilon, h)$

Higher expected income for the more educated motivates healthier behavior as the value of life increases

② Complementarity of health investments:  $\Gamma_t^{\text{ey}}(h'|h)$

Gains in life expectancy due to health behavior are more favorable for those with college education

③ Early life complementarities:  $\rho_{\text{PRO},e}^c$

Costs of better lifestyles may be related to costs of education (genes, parents, friends, neighborhood)

## Results cohort 1930s: summary

- The better income and health transitions of the more educated
  - Are key for education choices
  - Do not change much the marginal distribution of health behaviour
  - Narrow down the education gradients of health behavior
- Early life complementarities
  - They matter to understand the education gradients of health behavior between CG and HSG only

# Results cohort 1930s: figures

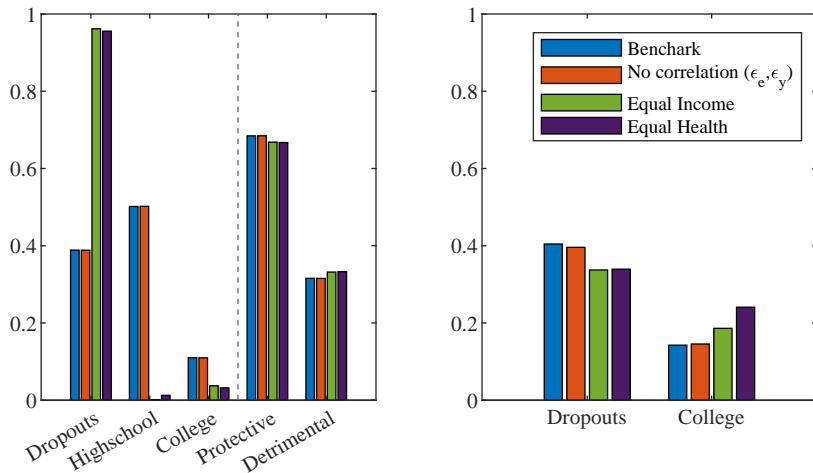


Figure: Education and Health Behavior

# Results cohort 1930s: table

Born in 1930	$\Pr(y = \text{PRO} e)$		$\Delta\text{LE}$
	$e = \text{HSD}$	$e = \text{CG}$	
Benchmark	40.4	14.2	6.2
$\rho_{\text{PRO},e}^c = 0$	39.6	14.5	6.1
$w_t^{\text{CG}} = w_t^{\text{HSD}}$	33.7	18.6	5.3
$\Gamma_t^{\text{CG}}(h' h) = \Gamma_t^{\text{HSD}}(h' h)$	33.9	24.1	0.7



# Mechanisms

## ① Increase in the education wage premium

- a) Increases (decreases) the fraction of  $e = \text{CG}$  ( $e = \text{HSD}$ ) individuals
- b) Effect on  $\Pr[y = \text{PRO} | e]$  and  $\text{LE}(e)$ 
  - Direct: return on health investments increases more for the more educated,

$$\Delta_c (V_0^{\text{CG}, \text{PRO}, c} - V_0^{\text{CG}, \text{DET}, c}) > \Delta_c (V_0^{\text{HSD}, \text{PRO}, c} - V_0^{\text{HSD}, \text{DET}, c})$$

→ This increases the education gradient in lifestyles and LE

- Selection: worse pool of individuals (in terms of  $\epsilon_{\text{PRO}}$ ) within CG and HSD
  - *Ex ante* ambiguous effect on education gradient in lifestyles and LE

## ② Increase in college enrollment fees

- Reversed patterns

## ③ Increase in the correlation of initial conditions

- Changes patterns of selection



## Results: summary

- Increase in the education wages premium accounts for most of the action
  - Direct effect: key for the increase in PRO individuals and LE among CG
  - Selection effect: key for the fall in PRO individuals and LE among HSD  
*(life prospects of HSD did not fall as much to justify fall in PRO)*
- Absent financial frictions, the increase in tuitions has very small traction
- 1/4th of the increase in the gradients accounted for the increase in the initial correlation between education and lifestyle shocks

## Three mechanisms

	CG	HSD	$\Delta_{CG,HSD}$	explained
$\Delta\text{Pr}(e)$	16.1	-28.7	44.8	
$\Delta\text{Pr}(y = \text{PRO} \mid e)$	4.8	-18.3	23.0	
$\Delta\text{LE}(e)$	0.4	-1.4	1.8	

## Three mechanisms

	CG	HSD	$\Delta_{CG,HSD}$	explained
$\Delta\text{Pr}(e)$	16.1	-28.7	44.8	
Wage increase	16.1	-29.1	45.2	101%
$\Delta\text{Pr}(y = \text{PRO}   e)$	4.8	-18.3	23.0	
Wage increase	1.6	-15.3	17.0	74%
$\Delta\text{LE}(e)$	0.4	-1.4	1.8	
Wage increase	0.1	-1.2	1.3	74%

## Three mechanisms

	CG	HSD	$\Delta_{CG,HSD}$	explained
$\Delta\text{Pr}(e)$	16.1	-28.7	44.8	
Wage increase	16.1	-29.1	45.2	101%
Tuition increase	-0.2	0.1	-0.3	-1%
$\Delta\text{Pr}(y = \text{PRO}   e)$	4.8	-18.3	23.0	
Wage increase	1.6	-15.3	17.0	74%
Tuition increase	0.2	-0.3	0.4	2%
$\Delta\text{LE}(e)$	0.4	-1.4	1.8	
Wage increase	0.1	-1.2	1.3	74%
Tuition increase	0.0	0.0	0.0	0%

## Three mechanisms

	CG	HSD	$\Delta_{CG,HSD}$	explained
$\Delta Pr(e)$	16.1	-28.7	44.8	
Wage increase	16.1	-29.1	45.2	101%
Tuition increase	-0.2	0.1	-0.3	-1%
Change initial conditions	0.2	0.0	0.2	1%
$\Delta Pr(y = PRO   e)$	4.8	-18.3	23.0	
Wage increase	1.6	-15.3	17.0	74%
Tuition increase	0.2	-0.3	0.4	2%
Change initial conditions	4.4	-1.6	6.0	26%
$\Delta LE(e)$	0.4	-1.4	1.8	
Wage increase	0.1	-1.2	1.3	74%
Tuition increase	0.0	0.0	0.0	0%
Change initial conditions	0.4	-0.1	0.5	28%

## Wage changes

	CG	HSD	$\Delta_{CG,HSD}$	explained
$\Delta\text{Pr}(e)$	16.1	-28.7	44.8	
$\Delta\text{Pr}(y = \text{PRO} \mid e)$	4.8	-18.3	23.0	
$\Delta\text{LE}(e)$	0.4	-1.4	1.8	

## Wage changes

	CG	HSD	$\Delta_{CG,HSD}$	explained
$\Delta\text{Pr}(e)$	16.1	-28.7	44.8	
Wage increase	16.1	-29.1	45.2	101%
$\Delta\text{Pr}(y = \text{PRO}   e)$	4.8	-18.3	23.0	
Wage increase	1.6	-15.3	17.0	74%
$\Delta\text{LE}(e)$	0.4	-1.4	1.8	
Wage increase	0.1	-1.2	1.3	74%

## Wage changes

	CG	HSD	$\Delta_{CG,HSD}$	explained
$\Delta\text{Pr}(e)$	16.1	-28.7	44.8	
Wage increase	16.1	-29.1	45.2	101%
$\Delta\text{Pr}(y = \text{PRO}   e)$	4.8	-18.3	23.0	
Wage increase	1.6	-15.3	17.0	74%
Direct effect	2.0	-1.5	3.4	26%
$\Delta\text{LE}(e)$	0.4	-1.4	1.8	
Wage increase	0.1	-1.2	1.3	74%
Direct effect	0.2	-0.1	0.3	17%



## Wage changes

	CG	HSD	$\Delta_{CG,HSD}$	explained
$\Delta\text{Pr}(e)$	16.1	-28.7	44.8	
Wage increase	16.1	-29.1	45.2	101%
$\Delta\text{Pr}(y = \text{PRO}   e)$	4.8	-18.3	23.0	
Wage increase	1.6	-15.3	17.0	74%
Direct effect	2.0	-1.5	3.4	26%
Selection effect	-0.4	-13.8	13.6	59%
$\Delta\text{LE}(e)$	0.4	-1.4	1.8	
Wage increase	0.1	-1.2	1.3	74%
Direct effect	0.2	-0.1	0.3	17%
Selection effect	-0.1	-1.1	1.0	56%



# Conclusions

- We developed a econometric model to summarize life styles exploiting health behavior and health outcomes.
- We solve and estimate an HA model with incomplete markets where education and lifestyle choices are made early in life.
- Differences in health transitions and income explain most of the differences in health behavior choices across education groups.