Spatial Health: How Smoking Shapes Our Neighborhoods?

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Introduction

- Neighborhoods are segregated not only by income, but also by health.
  - Within MSAs, LE is about 7 years higher in top- vs. bottom-decile income tracts.
- Drivers of income segregation through neighborhood spillovers are well understood
  Benabou (1996), Durlauf (1996), Fernandez and Rogerson (1996, 1998)
- But less is known about the mechanisms of health segregation.
- Understanding spatial health inequality matters:
  - Health is a major component of welfare
  - Health and income segregation may reinforce each other, creating local opportunity traps.

What Could Explain These Spatial Health Gaps?

- Income segregation alone could generate health segregation.
  - Higher-income individuals tend to make healthier choices.
- But the mechanisms driving income segregation are also present in health.
  - The local health environment matters, even beyond education spillovers.
    Norton (1998); Gaviria and Raphael (2001); Powell et al. (2005); Arduini et al. (2025)
    Ludwig et al. (2011); Christakis & Fowler (2007); Health & Place (2021)
- We focus on smoking:
  - it starts early in life
  - persists
  - strong predictor of longevity.

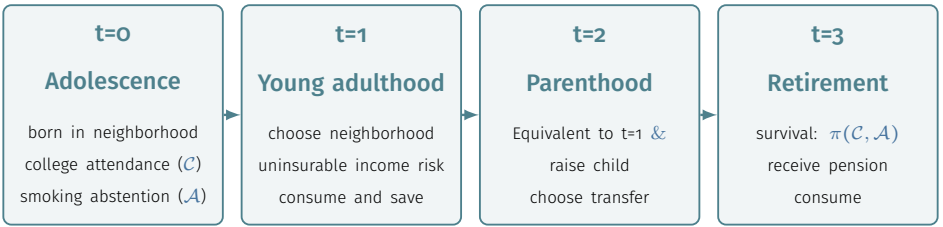
This Paper

- We develop an OLG model with multiple neighborhoods.
- Teens and parents make three decisions that shape health:
  1. Parents decide where to live
  2. Kids decide whether to attend college
  3. Kids decide whether to smoke
- Local externalities:
  - Health Behaviors: ↑ local smoking rate increases the probability of smoking.
  - Education: ↑ local college rate (better schools) raises college attendance.
- House prices adjust to clear neighborhood markets.

This Paper

- We estimate the model using data on the US: AddHealth, PSID, and HRS.
- We discipline spillover parameters using reduced-form exposure effects.
- We decompose neighborhood LE gaps btw rich and poor neighborhoods holding sorting fixed:
  - Equalizing education local spillovers effects closes the gap by 30%
  - Equalizing health local spillovers effects closes the gap by 17%
- Equilibrium effects amplify the role of local externalities:
  - Equalizing education local spillovers reduces LE gaps by 52%
  - Equalizing health local spillovers reduces mean income gaps by 10%
- We evaluate place-based policies through welfare and longevity gains.
  - 20% of welfare gains come from improvements in LE.

Model



one model period = 20 years

Preferences

- Individuals discount the future at a rate β
- The utility function is given by:

$$u(c) = \frac{c^{1-\gamma} - 1}{1-\gamma} + b,$$

where b is a constant capturing the joy of living.
Hall and Jones (2007)

- Richer individuals value longevity more because they have higher consumption flows.

Adolescence

- The teenager solves:

$$V_0(a_0, \mathcal{C}_p, \mathcal{A}_p, \epsilon_{\mathcal{C}}, \epsilon_{\mathcal{A}}, n) = \max_{\substack{c,\, a' \\ \mathcal{C},\, \mathcal{A} \epsilon \{0,1\}}} \Big\{ u(c) + \mathcal{C}\, u^{\mathcal{C}}(\mathcal{C}_p, \bar{\mathcal{C}}_n, \epsilon_{\mathcal{C}}) + \mathcal{A}\, u^{\mathcal{A}}(\mathcal{A}_p, \bar{\mathcal{A}}_n, \epsilon_{\mathcal{A}}) + \beta \mathbb{E} V_1(a', \mathcal{C}, \mathcal{A}, z', n) \Big\}$$

$$\text{s.t.} \quad c + a' = a_0 - \mathcal{C}\kappa_{\mathcal{C}} + (1 - \mathcal{C}) y_0$$

$$\underline{a} \leq a' \leq 0$$

Adolescence

- The utility shifters are given by:

$$u^{\mathcal{C}}(\mathcal{C}_p, \bar{\mathcal{C}}_n, \epsilon_{\mathcal{C}}) = \tau_0^{\mathcal{C}} + \tau_p^{\mathcal{C}}\mathcal{C}_p + \left(\tau_n^{\mathcal{C}} + \tau_{pn}^{\mathcal{C}}\mathcal{C}_p\right)\bar{\mathcal{C}}_n^{\rho_c} + \epsilon_{\mathcal{C}}$$

$$u^{\mathcal{A}}(\mathcal{A}_p, \bar{\mathcal{A}}_n, \epsilon_{\mathcal{A}}) = \tau_0^{\mathcal{A}} + \tau_p^{\mathcal{A}}\mathcal{A}_p + \left(\tau_n^{\mathcal{A}} + \tau_{pn}^{\mathcal{A}}\mathcal{A}_p\right)\bar{\mathcal{A}}_n^{\rho_a} + \epsilon_{\mathcal{A}}$$

$$\epsilon_{\mathcal{C}} \sim \mathcal{U}[-\sigma^{\mathcal{C}}, \sigma^{\mathcal{C}}], \qquad \epsilon_{\mathcal{A}} \sim \mathcal{U}[-\sigma^{\mathcal{A}}, \sigma^{\mathcal{A}}],$$

with $\epsilon_{\mathcal{C}}$ and $\epsilon_{\mathcal{A}}$ independent.

Young Adulthood, Parenthood, and Retirement

- Working life is divided into two periods:
  1. Young adulthood: agents first choose a neighborhood, then enter the labor market.
     - income depends on education, smoking status, and a persistent shock (z)
     - agents consume, save, and pay rent, cigarette costs, and medical expenditure
  2. Parenthood: + raise a child, and choose a wealth transfer.
- With probability $\pi(\mathcal{C}, \mathcal{A})$ the agent survives to retirement, where she consumes her pension and savings.

Value Function

Housing Market

- Housing prices are determined in equilibrium.
- The supply of housing is given by:

$$S_n = \Psi_n P_n^{\tau_h},$$

where τ_h drives the price elasticity of housing supply, Ψ_n are housing supply shifters

Data

- To estimate the model we are going to use AddHealth data.
- Tracks a representative cohort of US adolescents
  - $t = 0$: 1994-95 school year, grades 7-12.
  - $t = 1$: 2016-18, aged 34-40.
- Includes comprehensive data on the parent's smoking and college decisions.
- Contains tract-level statistics on neighborhood characteristics.
- Sample: 6,034 parent-child pairs.

Data

- We use three neighborhoods: $n \in \{A, B, C\}$.
- Add Health kids are assigned by tract income rank within their MSA:
  - A: bottom 30%
  - B: 30%–90%
  - C: top 10%

Estimation

Estimated parameters: smoking and college decision

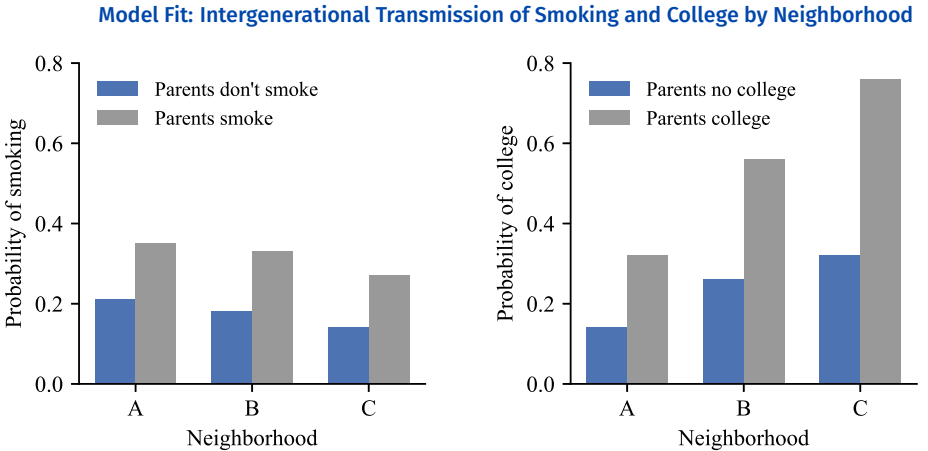
Parameter	Description	Value	
		$j = \mathcal{A}$	$j = \mathcal{C}$
τ_0^j	constant utility cost	-0.05	-0.55
τ_p^j	parental influence	0.29	0.90
τ_n^j	neighborhood influence	-0.68	-1.07
τ_{pn}^j	parent-neighborhood interaction	-0.00	-0.36
ρ_j	neighborhood-influence curvature	-0.98	-0.14
σ^j	support of ϵ^j	0.92	1.10

Estimation

Remaining estimated parameters

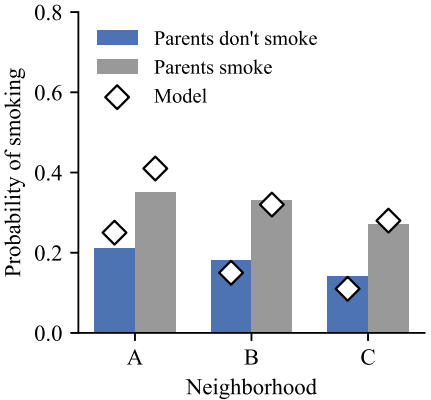
Parameter	Description	Value
b	value of life	12.30
β	annual discount factor	0.99
α	altruism parameter	0.51
μ_n	amenity in NBH B, C	0.07, 0.07
η_1, η_2	moving costs	0.03, 0.03
σ_n	Gumbel taste shock for NBH	0.04
λ	tax rate	0.77

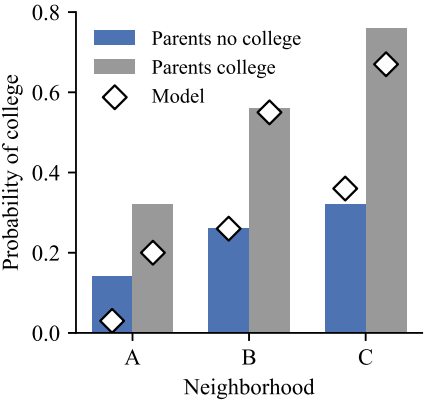
Estimation


Model Fit: Intergenerational Transmission of Smoking and College by Neighborhood
Probability of smoking
0.0
0.2
0.4
0.6
0.8
Parents don't smoke
Parents smoke
A
B
C
Neighborhood
Probability of college
0.0
0.2
0.4
0.6
0.8
Parents no college
Parents college
A
B
C
Neighborhood

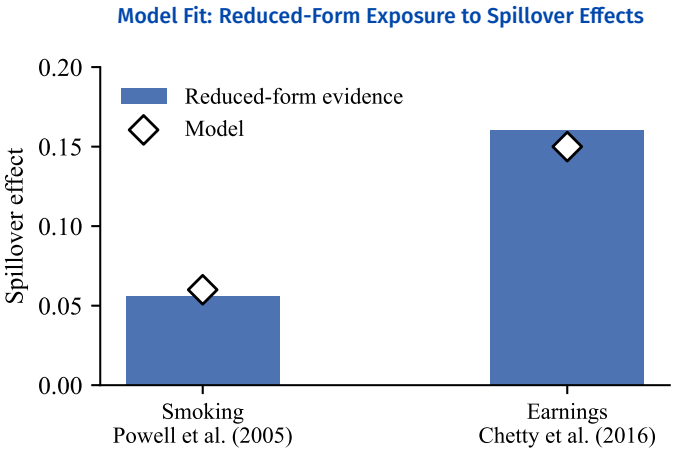
Estimation

Model Fit: Intergenerational Transmission of Smoking and College by Neighborhood





Estimation


Model Fit: Reduced-Form Exposure to Spillover Effects
Spillover effect
0.20
0.15
0.10
0.05
0.00
Reduced-form evidence
Model
Smoking
Powell et al. (2005)
Earnings
Chetty et al. (2016)

Estimation

Model Fit: Other Moments

Moments	Model	Data
VSL	$5.9 million	$6 millions
A/Y at age 40	4.12	4.32
Cost of raising a kid	170k	301k
% of living in NBH A, B, C	0.24, 0.66, 0.10	0.30, 0.60, 0.10
Average tax rate	0.34	0.35
Prob. of staying in NBH	0.71	0.71

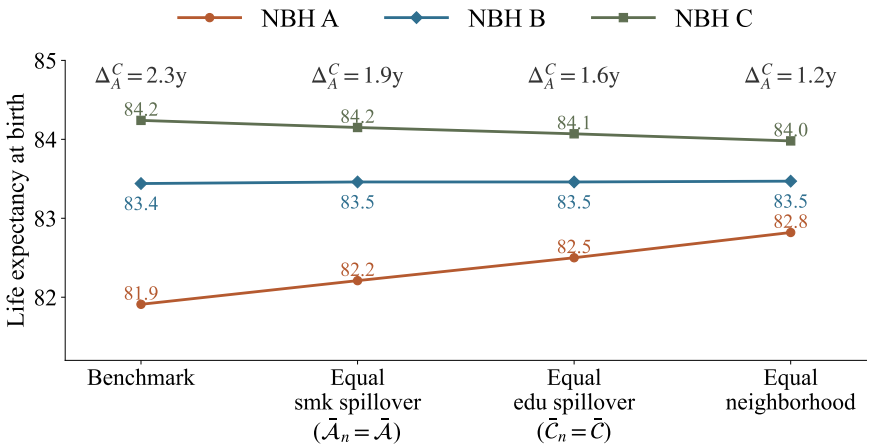
Transition probabilities	$n_1 = A$	$n_1 = B$	$n_1 = C$	$n_1 = A$	$n_1 = B$	$n_1 = C$
$\Pr(n_1 \mid n_0 = A)$	0.54	0.41	0.05	0.49	0.48	0.03
$\Pr(n_1 \mid n_0 = B)$	0.26	0.69	0.05	0.25	0.69	0.06
$\Pr(n_1 \mid n_0 = C)$	0.29	0.53	0.18	0.18	0.67	0.16

Parental Sorting vs. Local Effects

Decomposition

- We decompose neighborhood LE gaps at birth into:
  - Local effects: smoking and education spillovers.
  - Parental characteristics
- For children born in each neighborhood, we recompute LE under:
  - Equal education spillovers
  - Equal smoking spillovers
  - Common local environment
- The remaining gap captures differences in parental characteristics.

Parental Sorting vs. Local Effects



Life Expectancy at Birth Across Neighborhoods: Decomposition

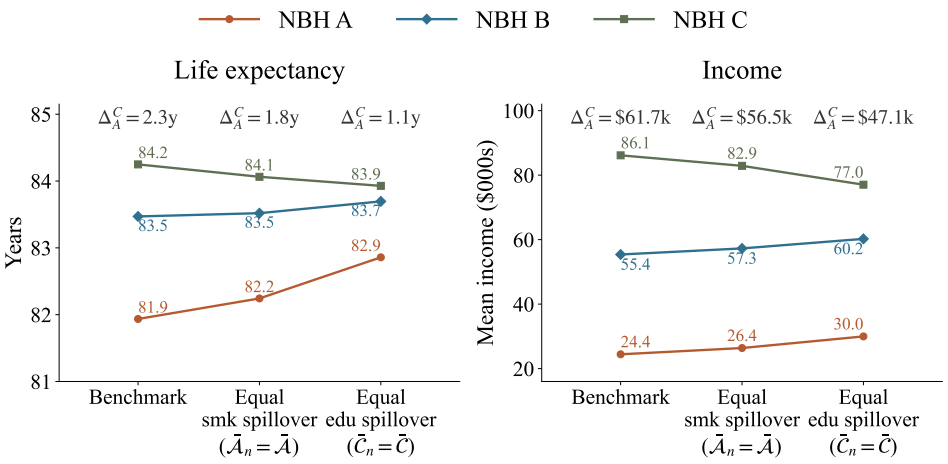
Counterfactual Equilibria

When Sorting Responds

- The previous decomposition holds neighborhood choices fixed.
- In equilibrium, changing spillovers also changes where families choose to live:
  - Parents re-sort across neighborhoods.
  - House prices adjust to clear housing markets.
- We quantify how these responses reshape segregation:
  - How much the education environment mediates health segregation?
  - How much smoking exposure mediates income segregation?

Counterfactual Equilibria

Neighborhood Outcomes

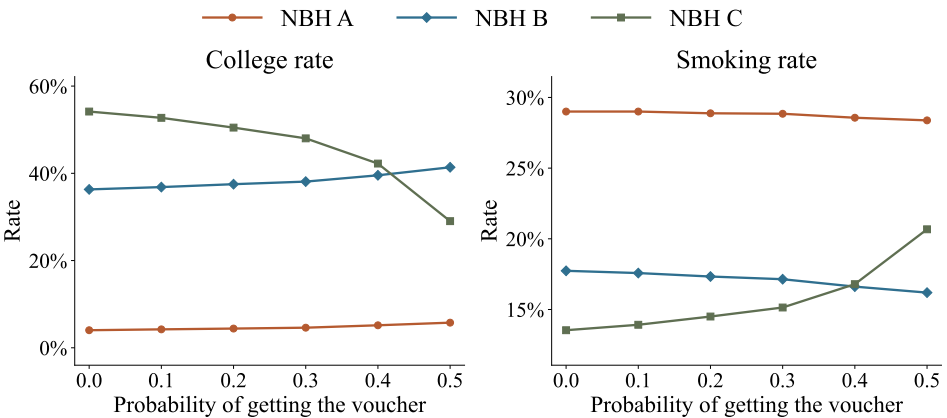


Welfare Benefits of Place-Based Policies

Modeling

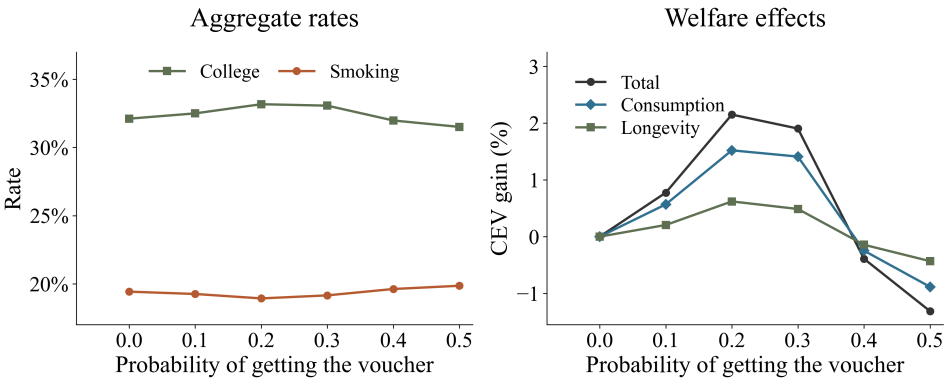
- At the beginning of period 2, some individuals become eligible for a housing voucher.
- Allows families to move to C at a subsidized price (MTO).
- Eligibility criteria:
  - Individuals in the bottom 20% of the income distribution.
  - Individuals living in neighborhood A.
- Scale of the policy:
  - Eligible individuals get a housing voucher with probability p
- We adjust the tax system to keep the government budget balanced.

Welfare Benefits of Place-Based Policies



Neighborhood Characteristics in the Voucher Policy Counterfactuals

Welfare Benefits of Place-Based Policies



Aggregate outcomes and Welfare Gains in the Voucher Policy Counterfactuals

Conclusions

- We develop a spatial equilibrium model with endogenous education, smoking and location decisions to understand the drivers of inequality in health across space.
- We find that 50% of the gap in life-expectancy across rich and poor neighborhoods is due to spillover effects.
- Spillover effects amplify segregation:
  - Equalizing education spillovers reduces LE gaps by 52%
  - Equalizing smoking spillovers reduces income gaps by 10%.
- 20% of the welfare gains from placed-based policies come from changes in life-expectancy

Appendix: Young Adulthood and Parenthood

- At the beginning of period 1 and period 2, the value function is:

$$V_t(a, \mathcal{C}, \mathcal{A}, z, n) = \mathbb{E}\Big[\max_{n'} \Big\{ \tilde{V}_t^{n'}(a, \mathcal{C}, \mathcal{A}, z, n) + \xi_{n'} \Big\} \Big],$$

  where $\tilde{V}_t^{n'}(a, \mathcal{C}, \mathcal{A}, z, n)$ is the neighborhood-specific value function.

- We assume $\xi_{n'}$:
  - i.i.d. across neighborhoods and periods
  - type-I extreme value distributed with scale parameter σ_n.

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Appendix: Parenthood

- The neighborhood-specific value function during parenthood is given by:

$$\begin{aligned}\tilde{V}_2^{n'}(a,\mathcal{C},\mathcal{A},z,n) = \max_{c,a',a_0^k} & \; u(c) + \mu_{n'} - \mathbf{1}_{\{n'\neq n\}}\cdot\eta_2 \\ & + \beta\pi(\mathcal{C},\mathcal{A})\mathbb{E}_{z'}\Big[V_3(a',\mathcal{C},\mathcal{A},z',n')\Big] \\ & + \alpha\mathbb{E}_{\epsilon_\mathcal{C},\epsilon_\mathcal{A}}\Big[V_0(a_0^k,\mathcal{C},\mathcal{A},\epsilon_\mathcal{C},\epsilon_\mathcal{A},n')\Big]\end{aligned}$$

$$\text{s.t.} \quad c + a' + a_0^k = T(y_2(\mathcal{C},\mathcal{A},z)) + (1+r)a - 2P_{n'} - m(\mathcal{C},\mathcal{A}) - (1-\mathcal{A})\tau_{\text{cig}},$$

where

η_2: non-pecuniary moving cost

$P_{n'}$: rental price in neighborhood n'

$m(\mathcal{C},\mathcal{A})$: medical expenditure

$\mu_{n'}$: amenity value

α: altruism parameter

a_0^k: initial assets of the kid

$\pi(\mathcal{C},\mathcal{A})$: survival probability

τ_{cig}: cigarette cost

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