Spatial Health

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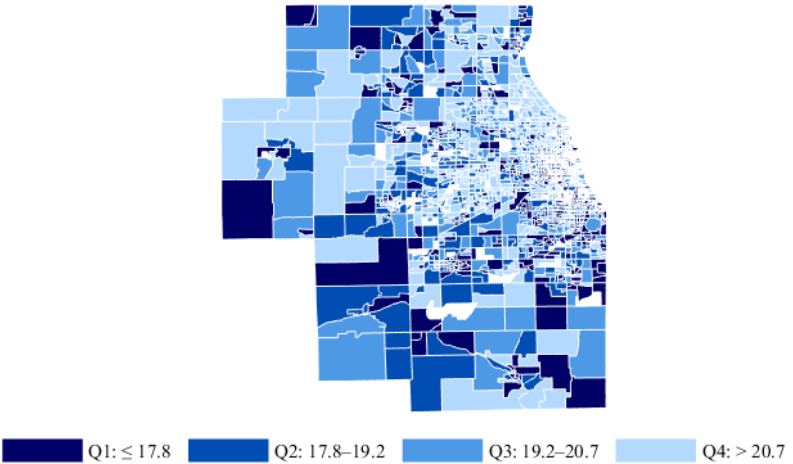
Life-Expectancy at Age 65: Chicago



What Could Explain These Spatial Health Gaps?

- Health is spatially segregated even within small geographic areas
- What generates these spatial differences?
  1. Sorting: healthier individuals choose different places to live.
  2. Local effects: the place where you grow up shapes your health
- Understanding what drives spatial health inequality is essential for evaluating place-based policies:
  - If spatial inequality reflects mostly sorting, then moving individuals across space would have limited impact on their health.

What Could Explain These Spatial Health Gaps?

- To understand spatial health disparities, we need to identify what determines health.
- Health outcomes are to a large extent shaped by early-life choices:
  - Education
  - Health behaviors (mostly smoking)
- A large literature shows that both are heavily influenced by:
  - Parental background
  - Neighborhood environment and peers

This Paper

- We develop an OLG model with multiple neighborhoods.
- Teens and parents make three decisions shaping life expectancy:
  1. Neighborhood
  2. Education
  3. Smoking
- Local externalities:
  - Health Behaviors: A higher local smoking rate increases the probability of smoking.
  - Education: More affluent neighborhoods (better schools) raise the probability of attending college.
- House prices adjust to clear neighborhood markets.

This Paper

- Quantify the role of:
  - Sorting across neighborhoods
  - Local externalities in education and health behavior
- Explain observed life-expectancy gaps across neighborhoods:
  - How much comes from parental background?
  - How much from neighborhood spillovers?
- Quantify to which extent changes in welfare from placed-based policies come from consumption versus health.
- Scaling-up placed based policies and analyze its impact on welfare

Literature

- Empirical literature has identified peer effects play a key role in smoking
  Argys and Rees (2008), Lundborg (2006), Card and Giuliano (2013), Arduini et al (2025)

- Understanding differences in health inequalities across SES through health behavior choices
  Cole et al. (2019); Mahler, Yum (2023); Margaris and Wallenius (2023); Bueren et al. (2025)
  → We focus on the spatial dimension to understand health inequalities

- Recent spatial quantitative literature analyzing the welfare consequences of income segregation
  Chyn and Daruich (2025); Fogli et al. (2025); Eckert and Kleineberg (2025)
  → We analyze how health drives economic segregation and welfare

- Health in space
  Margaris and Wallenius (2025)
  → Write an equilibrium model where spillovers are endogenous to analyze how placed based policies affect welfare

Model

- We build an OLG model with 3 phases:
  1. Adolescence: individuals are born in a given neighborhood and decide education and smoking decision.
  2. Prime: enter the labor market, then have a kid and decide where to live taking as given education and smoking decisions.
  3. Retirement: individuals face survival uncertainty.
- 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.

Adolescence

- A teenager is born in a given neighborhood n.
- Receives an parental transfer a_0
- Decides whether to smoke or not and whether to go to college or not.
- Are heterogeneous in terms of the utility of smoking and going to college
- Utility depends on:
  - Parental background: college ($\mathcal{C}^p$) and smoking ($\mathcal{S}^p$)
  - Neighborhood characteristics: fraction of smokers ($\bar{S}_n$) and average income ($\bar{y}_n$)
  - Idiosyncratic shocks related to college (ϵ_e) and smoking (ϵ_s)

Adolescence

- The teenager solves:

$$V_0(a_0, \mathcal{C}_p, \mathcal{S}_p, \epsilon_c, \epsilon_s, n) = \max_{c,\, a',\, \mathcal{C}\in\{1,0\},\, \mathcal{S}\in\{1,0\}} u(c) + u^{\mathcal{S}}(\mathcal{S}_p, \bar{\mathcal{S}}_n, \epsilon_s) + u^{\mathcal{C}}(\mathcal{C}_p, \bar{y}_n, \epsilon_c) + \beta \mathbb{E} V_1(a', \mathcal{C}, \mathcal{S}, z')$$

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

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

$$u^{\mathcal{S}}(\mathcal{S}_p, \bar{\mathcal{S}}_n, \epsilon_c) = \mathcal{S}\Big[\alpha_s + \gamma_s \bar{\mathcal{S}}_n^{\rho_s} + \delta_s \mathcal{S}_p + \epsilon_s\Big], \;\; \epsilon_s \sim \mathcal{U}[-\sigma_s, \sigma_s]$$

$$u^{\mathcal{C}}(\mathcal{C}_p, \bar{y}_n, \epsilon_c) = \mathcal{C}\Big[\alpha_c + \gamma_c \bar{y}_n^{\rho_c} + \delta_c \mathcal{C}_p + \epsilon_c\Big], \;\; \epsilon_c \sim \mathcal{U}[-\sigma_c, \sigma_c]$$

where $\epsilon_{\mathcal{C}}$ and $\epsilon_{\mathcal{S}}$ are assumed to be independent.

Prime Age

- The prime age phase is divided into two periods:

  Period 1: individuals enter the labor market.

  - receive an exogenous income depending on education and a persistent shock (z)
  - make a consumption savings decision

  Period 2: on top individuals have a kid, decide where to live, and how much wealth to transfer to the kid.

Prime Age

Period 1

- In period 1 they solve:

$$V_1(a, \mathcal{C}, \mathcal{S}, z) = \max_{c, a'} u(c) + \beta \mathbb{E} V_2(a', \mathcal{C}, \mathcal{S}, z')$$
$$\text{s.t.} \quad c + a' = T(y_1(\mathcal{C}, \mathcal{S}, z)) + (1 + r)a$$

Prime Age

Period 2

- In period 2, the value function is given by:

$$V_2(a, \mathcal{C}, \mathcal{S}, z) = \mathbb{E}\Big[\max_n \Big\{\tilde{V}_2^n(a, \mathcal{C}, \mathcal{S}, z) + \epsilon_n\Big\}\Big],$$

  where $\tilde{V}_2^n(a, \mathcal{C}, \mathcal{S}, z)$ the neighborhoods-specific value functions.

- We assume ϵ_n to be i.i.d across neighborhoods and type-I extreme value distributed with scale parameter σ_n.

Prime Age

Period 2

- Choice specific value functions are given by:

$$\tilde{V}_2^n(a,\mathcal{C},\mathcal{S},z) = \max_{c,a',a_0^k} u(c) - \mu_n + \beta\mathbb{E}_z\Big[V_3(a',\mathcal{C},\mathcal{S},z')\Big] + \alpha\mathbb{E}_{\epsilon_\mathcal{C},\epsilon_\mathcal{S}}\Big[V_0(a_0^k,\mathcal{C},\mathcal{S},\epsilon_\mathcal{C},\epsilon_\mathcal{S},n)\Big]$$
$$\text{s.t.} \quad c + a' + a_0^k = T(y_2(\mathcal{C},\mathcal{S},z)) + (1+r)a - P_n$$

μ_n: utility flow from living in neighborhood n

P_n: price of living in neighborhood n

α: altruism parameter

a_0^k: initial assets of the kid

Retirement

- During retirement (two subperiods), individuals receive a pension which is a function of their education and the last productivity shock
- They make a consumption/saving decision

$$V_3(a,\mathcal{C},\mathcal{S},z) = \max_{c,a'} u(c) + \beta\delta_s(\mathcal{C},\mathcal{S})V_4(a',\mathcal{C},\mathcal{S},z)$$
$$\text{s.t.} \quad c + a' = T(\omega(\mathcal{C},\mathcal{S},z)) + (1+r)a$$
$$V_4(a,\mathcal{C},\mathcal{S},z) = u\Big((1+r)a + T(\omega(\mathcal{C},\mathcal{S},z))\Big)$$

$\delta_s(\mathcal{C},\mathcal{S})$: survival probability

Housing Market

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

$$S_n = A_n P_n^{\tau},$$

where τ drives the price elasticity of housing supply, A_n are housing supply shifters

Equilibrium

- A stationary equilibrium in this economy is:
  - a set of neighborhood, education, smoking, parental transfer decisions
  - house prices
  - average smoking rates and income defining neighborhood qualities

  such that:
  - hh decision are optimal given prices and neighborhood qualities,
  - Housing market clears
  - Neighborhood qualities are consistent with the households decisions

Data

- To estimate the model we are going to use AddHealth data.
- Tracks a cohort of adolescents from grades 7-12 in the US during the 1994-95 school year through several follow-up waves: 1996, 2001-02, 2008-09, and 2016-18.
- Wave 1 includes comprehensive data on the parents smoking and college decisions
- Tract-level statistics using Census on income and house prices
- Sample: 6,034 parent-child pairs

Data

- We set the number of neighborhoods equal to three: $n \in \{A, B, C\}$
- We assign kids in Addhealth to neighborhoods depending on the income distribution of the tract with respect to the MSA in which they lived:
  - A: income in the bottom 30%
  - B: income in 30%-90%
  - C: income in the top 10%

Estimation

- We follow a standard 2 step procedure:

  External:

  - Wages $y_t(\mathcal{C}, z)$ (PSID)
  - Survival probabilities $\delta_s(\mathcal{C}, \mathcal{S})$ (HRS)
  - College costs $\tau_{\mathcal{S}} = 60k$
  - House Prices: $P_A = 174k$; $P_B = 253k$; $P_C = 374k$
  - Elasticity of housing supply: 1.75 (Saiz, 2010)
  - Replacement rate: 0.494 (OECD, 2019)

Estimation

Internal: The remaining parameters are estimated internally.

We use Add Health data to match:

- College graduation rates conditional on neighborhood and parental education
- Smoking rates conditional on neighborhood and parental smoking
- Parental transfers
- Value of Statistical Life
- Asset to income ratio
- Average marginal tax rate
- Intergenerational mobility

Estimation

Estimated parameters: smoking and college decision

Parameter	Description	Value	
		$\mathcal{S}$	$\mathcal{C}$
$\alpha_{\mathcal{S}\|\mathcal{C}}$	constant	-1.72	-4.15
$\delta_{\mathcal{S}\|\mathcal{C}}$	parental influence	0.27	0.44
$\gamma_{\mathcal{S}\|\mathcal{C}}$	neighborhood effect	1.55	2.75
$\rho_{\mathcal{S}\|\mathcal{C}}$	curvature	0.37	0.08
$\sigma_{\mathcal{S}\|\mathcal{C}}$	support of $\epsilon_{\mathcal{S}\|\mathcal{C}}$	0.96	0.83

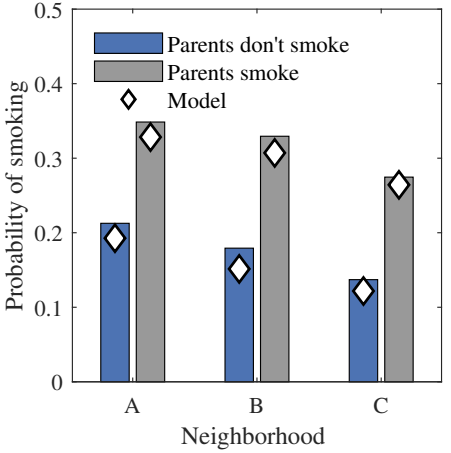
Estimation

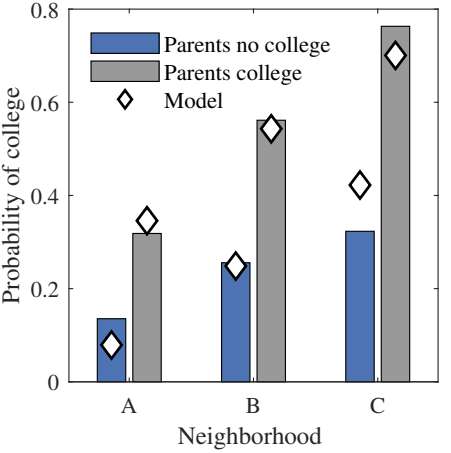
Remaining estimated parameters

Parameter	Description	Value
b	value of life	10.30
β	annual discount factor	0.98
α	altruism parameter	0.68
μ_n	amenity in NBH B, C	0.14, 0.15
σ_n	Gumbel taste shock for NBH	0.02
λ	tax rate	0.77

Estimation

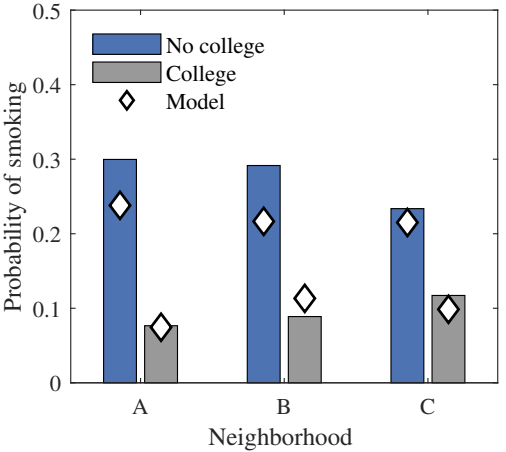
Model Fit: Smoking and College by Neighborhood and Parental characteristics





Estimation

Model Fit: Smoking by Neighborhood and College Decision



Estimation

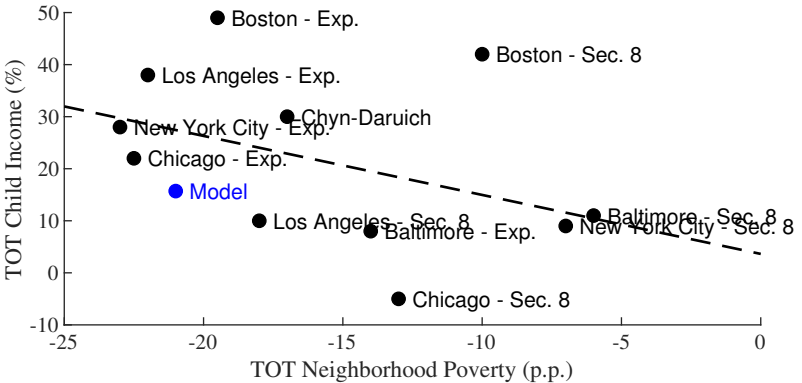
Model Fit

Moments		Model			Data		
VSL		$ 6.6 million			$ 6 millions		
A/Y at age 40		4.33			4.32		
Cost of raising a kid		462k			301k		
% living in good NBH A,B,C		0.29, 0.62, 0.09			0.3, 0.6, 0.1		
Average tax rate		0.34			0.35		
		$n' = A$	$n' = B$	$n' = C$	$n' = A$	$n' = B$	$n' = C$
Transition probabilities	$Pr(n'\|A)$	0.36	0.60	0.04	0.49	0.48	0.03
	$Pr(n'\|B)$	0.28	0.62	0.10	0.25	0.69	0.06
	$Pr(n'\|C)$	0.17	0.65	0.18	0.18	0.67	0.16

Validation

- We benchmark the model against evidence from the Moving to Opportunity (MTO) experiment:
  - Families in public housing were randomly offered housing vouchers.
  - Certain vouchers required relocating to neighborhoods with substantially lower poverty rates.
  - The program generated sizable gains for children exposed at young ages
    Chetty, Hendren, and Katz (2016)
- Model-based analogue:
  - Parents in the bottom 10% of the income distribution living in the poor neighborhood is granted a relocation voucher to richest neighborhood.
  - Partial equilibrium: local prices and neighborhood characteristics are held constant.

Validation

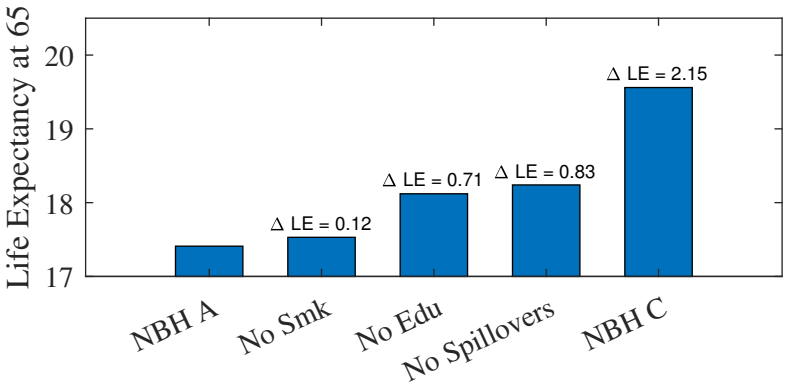


MTO experiment: model vs data

Parental Sorting vs. Local Effects

- We decompose the LE gap across birth neighborhoods into:
  - Local effects: differences in neighborhood spillovers on smoking and education.
  - Sorting: differences in parental characteristics.
- Counterfactuals: for children born in NBH A, we simulate life expectancy if A had:
  - the smoking externality of NBH C,
  - the education externality of NBH C,
  - both externalities replaced by those of NBH C.
- The remaining gap after replacing both externalities is due to parental characteristics.

Parental Sorting vs. Local Effects



Life Expectancy at Age 65 Across Neighborhood Scenarios

Parental Sorting vs. Local Effects

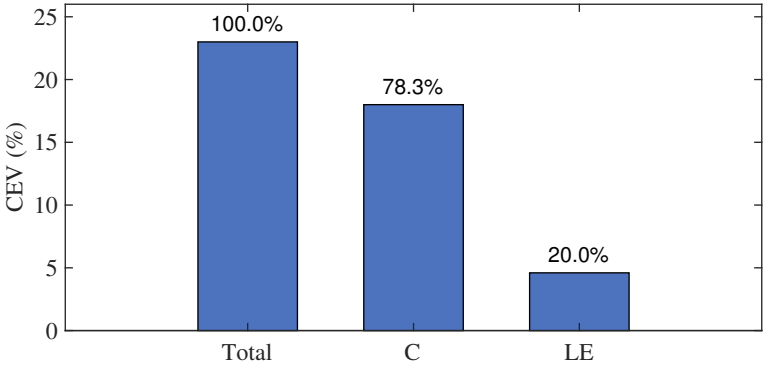
- Total LE gap (NBH C- NBH A): 2.15 years
- Sources of the gap:
  - Smoking spillover: 0.12 years (6%)
  - Education spillover: 0.71 years (33%)
  - Both spillovers combined: 0.83 years (39%)
  - Remaining difference due to parental characteristics: 1.32 years (61%)

Welfare Benefits of Place-Based Policies

- We evaluate the welfare gains from housing voucher programs for low-income families.
- Decompose welfare gain comes from
  - Consumption improvements
  - Health / life expectancy improvements
- Two perspectives:
  - Small scale: local prices and neighborhood characteristics are fixed. Measures direct effect on beneficiaries.
  - Scaling-up the program: neighborhood composition, housing prices, and local externalities change. Captures economy-wide feedback on welfare.

Welfare Benefits of Place-Based Policies

Small scale



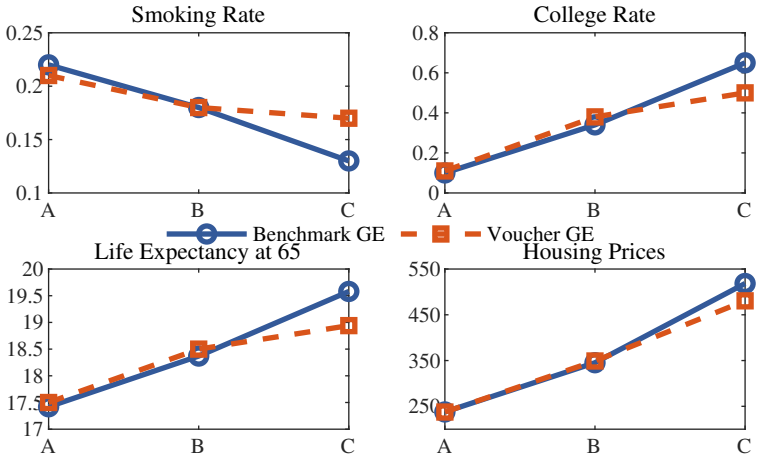
Welfare Decomposition of Placed based Policies: Consumption and Health

General Equilibrium Effects of the Voucher Policy

- In general equilibrium, the voucher program is scaled up:
  - Eligible individuals can move to NBH C while paying only 60% of the housing price in C.
- Unlike the small-scale experiment, neighborhood conditions now adjust endogenously:
  - Changes in the inflow of families modify smoking and college externalities.
  - Neighborhood life expectancy shifts accordingly.
  - Housing prices react to changes in demand across locations.
- We now quantify how the program alters neighborhood quality and prices once these general equilibrium feedbacks are taken into account.

Welfare Benefits of Place-Based Policies

General Equilibrium



Equilibrium Effects of Placed based Policies

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 60% of the gap if life-expectancy across the bottom 10 and the bottom 30 percent in income distribution is explained by differences in parental characteristics.
- Local spill-overs explain the rest (mostly in education)
- 20% of the welfare gains from placed based policies come from changes in life-expectancy
- When scaled up, placed based policy deteriorate local spillover in more affluent neighborhoods but generate overall welfare gains