The Impact of Racial Segregation on College Attainment in Spatial Equilibrium

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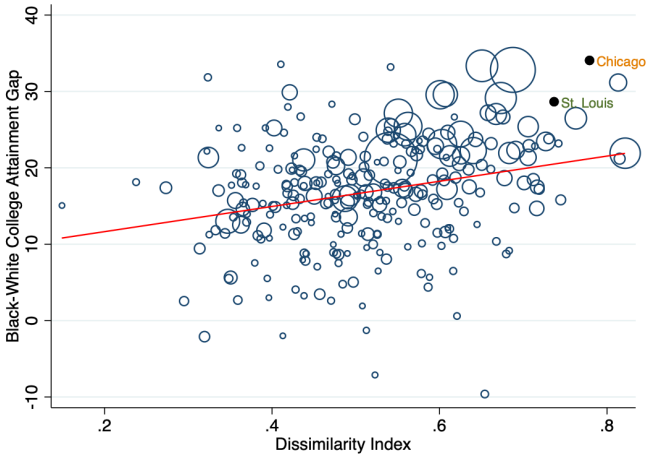
The views expressed herein are solely those of the authors and do not necessarily reflect the views of the Federal Reserve Bank of St. Louis or the Federal Reserve System.

Black-White College Gap and Racial Segregation

- Large literature arguing that a child's neighborhood matters for their adult outcomes
- Racial and economic segregation are predominant features of many American cities
- Racial inequality in exposure to "high-quality" neighborhoods (Bayer et al., 2021)

Do racial differences in exposure to high-quality neighborhoods explain the Black-White college gap?

Black-White College Gap and Segregation in the US



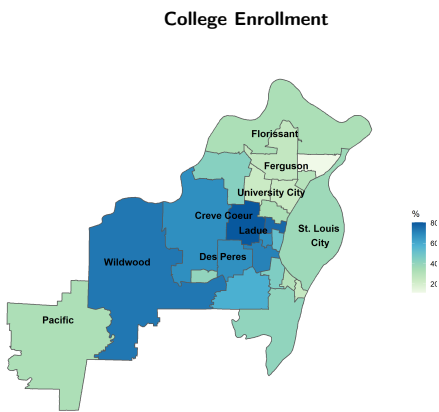
College graduation

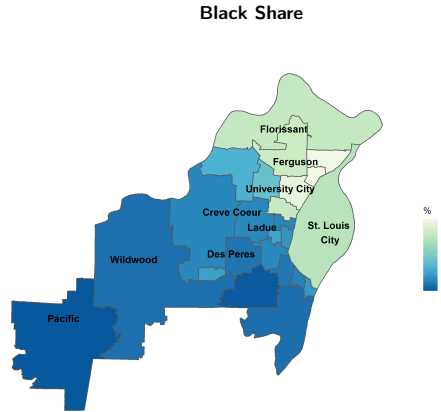
	US	STL	CHI
White, %	44	47	56
Black, %	23	19	22
Gap, p.p.	21	28	34

corr(gap,dissimilarity) = 0.43

▷ College gap time series

St. Louis: High Correlation between Race and College Enrollment





Correlation(college enrollment,black share) = - 0.63

Spatial Equilibrium Model with Spillovers and Race

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  1. Black-White wage gap
     Gap in lifetime earnings between Black and White households

  2. Amenity externalities: households care about the racial composition of neighbors
     Fear of discrimination in all White neighborhood, White flight, homophily

  3. Moving costs vary by race
     Differences in borrowing constraints, discrimination in housing markets, information frictions

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  3. Moving costs vary by race
     Differences in borrowing constraints, discrimination in housing markets, information frictions
- General equilibrium neighborhood effects:
  - Rental markets
  - Human capital spillovers
    Peer effects, networks, school quality
  - Racial composition
    Matters due to amenity externalities

The Impact of Racial Segregation on College Attainment

- Model explains 80% of Black-White college gap and the level of segregation in St. Louis
  - The wage gap has a direct effect on the college gap, but a minor effect on segregation
  - The amenity externalities and the mobility costs have direct effects on segregation
  - Changes in segregation affect the exposure to high-quality neighborhoods and the college gap

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  - Changes in segregation affect the exposure to high-quality neighborhoods and the college gap
- Escaping segregation traps
  - Spillovers + amenity externalities $\Longrightarrow$ multiple equilibria
  - Economy can coordinate to live in a less segregated equilibrium

Related Literature

- **Empirical literature on racial differences and causes and consequences of segregation**
  - Neal and Johnson (1996); Cutler and Glaeser (1997); Cameron and Heckman (2001); Card and Rothstein (2007); Boustan (2013); Ananat (2011); Billings et al. (2013); Chetty et al. (2016); Jackson et al. (2016); Hyman (2017); Chetty and Hendren (2018a,b); Graham (2018); Monarrez and Schönholzer (nd); Biasi (2021); Derenoncourt (2022); Karger and Wray (2023)
- **Spatial equilibrium models of racial segregation**
  - Schelling (1969, 1971)
  - Sethi and Somanathan (2004); Banzhaf and Walsh (2013); Bayer and McMillan (2005); Bayer et al. (2004); Caetano and Maheshri (2021); Christensen and Timmins (2023)

  Do not consider the impact on human capital accumulation
- **Neighborhood spillovers in human capital accumulation**
  - Fernandez and Rogerson (1996); Brock and Durlauf (1995); Benabou (1996)
  - Fogli and Guerrieri (2019); Zheng and Graham (2022); Eckert and Kleineberg (2019); Aliprantis and Carroll (2018); Chyn and Daruich (2022); Gilraine et al. (2023)

  Do not consider race
- **Our contribution:** Add race to a spatial model with education and neighborhood spillovers
  - Badel (2015)

Road Map

1. Model
2. Empirical results to quantify the model
3. Calibration and validation
4. Counterfactual analysis of racial differences
5. Multiple equilibrium

Model

Model

- Overlapping generations who each live 2 periods
- Households are of race r in $\{B, W\}$ which impacts:
  - Wages: calibrated Black-White wage gap
  - Amenity externalities: preferences over the racial composition of the neighborhood
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- 3 neighborhoods n in $\{A, B, C\}$, with 3 equilibrium characteristics:
  - Rent: p_n
  - Local spillover: X_n, college share
  - Racial composition: $S_{r,n}$, population share of each race

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- Timing:
  - Adults choose their neighborhood
  - They decide how much to consume and invest in their child
  - The child is born, realization of ability and education preference shock
  - Child chooses education level, e in $\{e^L, e^H\}$, with which they will enter adulthood

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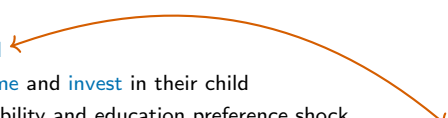

Adult Problem: Consumption, Investment, and Neighborhood Choices

$$V(r, a, s, e, n_0, n) = \max_{c,i} \log(c) + \log\left(A(n, r, S_{r,n})\right) + \beta \mathbb{E}_{e,a}\left[\mathcal{V}\left(r, a', s', e', n\right)\right]$$

subject to

$$\begin{aligned} c + i + p_n + m(r)\,\mathbb{I}\{n \neq n_0\} &= y(r, e, s) \\ a' &\sim \Gamma(a) \\ s' &= F^s(a', i, X_n) \\ P(e' = e^H) &= G^e\left(r, a', s', n\right) \end{aligned}$$

- Amenity externalities: neighborhood valuation depends on racial composition, $S_{r,n}$
- Mobility cost: depends on race
- Income: depends on race, education, and skills
- Local spillover: share of college-educated adults, X_n

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- Mobility cost: depends on race
- Income: depends on race, education, and skills
- Local spillover: share of college-educated adults, X_n
- Neighborhood choice:

$$\mathcal{V}(r, a, s, e, n_0) = \max_n \{V\left(r, a, s, e, n_0, n\right) + \varepsilon^n\}$$

ε^n: neighborhood preference shock drawn from a type 1 extreme value distribution

Child's Problem: Education Choice

- Skill formation:

$$\log s = \theta_c + \underbrace{\theta_a \log(a) + \theta_i \log(i)}_{\text{individual}} + \underbrace{\theta_X \log(X_n)}_{\text{neighborhood}}$$

- Skill affects: (i) income, (ii) education cost

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- Education choice:

$$e = \underset{\{e^L, e^H\}}{\text{argmax}} \{\mathcal{V}\left(r, a, s, e^L, n\right) + \sigma^L, \mathcal{V}\left(r, a, s, e^H, n\right) - \underbrace{(\bar{c} - s)}_{\text{educ. cost}} + \sigma^H\}$$

  - The cost of acquiring education is decreasing in skill
  - σ^H, σ^L are preference shocks drawn from a type 1 extreme value distribution

Three General Equilibrium Forces

- Housing: elastically supplied, $S_n = \eta_n p_n^{\psi}$
- Local spillovers: X_n, share of adults with high education by neighborhood
- Amenity externalities: $S_{r,n}$, race shares by neighborhood

▷ Equilibrium Definition

Intergenerational Channels

- Ability: imperfectly transferred from parent to child
- Parental investment: as transfers between parent and child
- Neighborhood:
  - Spillovers: living in a high-quality neighborhood is a complementary way of investing in child's skills
  - Moving costs: persistence in neighborhood choice across generations

Quantification

Calibration Strategy

Focus on St. Louis MSA

- **Estimations:**

1. Three neighborhoods
2. Moving across neighborhoods
   Black households $\approx$ 6 p.p. less likely to move
3. Black-White wage gap
   Race penalty of $\approx$ 8%
4. Amenity externalities

Sources of racial differences

5. Skills and education

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- **Calibration:** some external and some internal, to match the data
- **Validation:** replicate causal effects from the literature

1. Neighborhood Segregation

Use a k-means clustering of Census tracts based on: (i) household income, (ii) house prices, (iii) share of adults with college degree, and (iv) Black share

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	All	Cluster A	Cluster B	Cluster C
Population Share	1.00	0.17	0.62	0.21
Black Share	0.20	0.78	0.09	0.07
College Share of Adults	0.28	0.15	0.23	0.53
Income ($)	57,835	33,273	55,405	84,749
Median House Price ($)	171,749	82,699	150,060	307,244

Notes: K-means clustering for St. Louis MSA. Data from 2000 Census and (Chetty et al., 2018)

- A: Black (78%) and low-income ($33k)
- B: White (91%) and middle-income ($55k)
- C: White (93%) and high-income ($85k)

▷ Map

2. Moving Across Neighborhoods

Why include an additional neighborhood mobility cost for Black households?

- Differential moving costs to capture a range of forces including:
  - Differences in borrowing constraints
  - Discrimination in housing markets
  - Information frictions

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- Differential moving costs to capture a range of forces including:
  - Differences in borrowing constraints
  - Discrimination in housing markets
  - Information frictions
- Target: Racial difference in the intergenerational neighborhood moving probability controlling for:
  - Childhood household income
  - Parents education
  - Childhood neighborhood fixed effects
- Black households $\approx$ 6 p.p. less likely to move across neighborhood types

▷ Estimation

3. Black-White Wage Gap

Mincer regression in NLSY-97:

$$\log(\text{earnings}_i) = \alpha\ \text{race}_i + \beta\ \text{college}_i + \underbrace{\chi\ \log(ASVAB_i)}_{\text{skill}} + \delta\ \text{gender}_i + \varepsilon_i$$

Which implies

$$y(r, e, s) = w(r, e)\ s^{\chi}$$

	White	Black
Wage, below college	1.00	0.92
Wage, college	1.71	1.58
Return to skill, χ	0.19	0.19

Gaps consistent with the literature (Neal and Johnson, 1996; Heckman et al., 2006)

▷ Time series

4. Amenity Externalities

Why do amenities depend on racial composition?

- Homophily, discrimination (Becker and Murphy, 2000)

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Functional Form:

- Penalty on exogenous amenities (Banzhaf and Walsh, 2013):

$$A(n, r, S_{r,n}) = A_n\left(1 - \varphi_r \left(S_{r,n} - \gamma_r\right)^2\right)$$

- Utility from exogenous amenities A_n decreases as racial composition differs from ideal
- $S_{r,n}$ is the share of population of race r in n
- γ_r is the "bliss point" for racial composition
- φ_r is a weight on the penalty

4. Calibration of Amenity Externalities $\varphi_r \left(S_{r,n} - \gamma_r\right)^2$

1. γ_r: Survey evidence: $\gamma_B = 0.5$, $\gamma_W = 0.9$ (Farley et al., 1997; Krysan and Farley, 2002) ▷ Details
2. φ_r: Causal effect of racial composition on neighborhood choice (Caetano and Maheshri, 2021)

4. Calibration of Amenity Externalities $\varphi_r \left(S_{r,n} - \gamma_r\right)^2$

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2. φ_r: Causal effect of racial composition on neighborhood choice (Caetano and Maheshri, 2021)
   - If the Black share in a neighborhood rises by 10 p.p., the selection probability:
     - Declines by 2.8% for rich white households
     - Increases by 3.5% For rich Black households
   - Larger responses to race than income
   - Similar findings in the literature Bayer et al. (2004); Bayer and McMillan (2005); Bayer et al. (2017); Boustan (2013); Card et al. (2008)

	White		Black	
	Rich	Poor	Rich	Poor
Response to:				
Black Share	-2.83***	-2.25***	3.45***	2.41***
Poor Share	-0.69***	3.60***	-2.35***	0.44

5. Skills and Education

Model:

- $\log s = \theta_s + \underbrace{\theta_a \log(a) + \theta_i \log(i)}_{\text{individual}} + \underbrace{\theta_X \log(X_n)}_{\text{neighborhood}}$
- Education cost depends on skill, s

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Target moments:

1. Importance of parental investment on skills: covariance(s, i)
2. Importance of skill for education: $\text{educ}_i = \alpha + \beta\, s_i + \varepsilon_i$
3. Spillovers: Ratio college share neighborhood C to A, $\frac{X_C}{X_A}$

Map between model and data from NLSY-97 and Census:

Model	Data
s = skill	ASVAB score
a = ability	*unobserved*
i = investment	parental transfers
X_n = neighborhood college share	neighborhood college share

▷ New version

Calibration: External Parameters

Parameter	Description	Value	Source
β	Discount factor	0.97^{40}	
γ_B	Bliss points for Black households	0.50	Banzhaf and Walsh (2013)
γ_W	Bliss points for White households	0.90	Banzhaf and Walsh (2013)
$w(B, L)$	Relative wage of Black, low education	0.92	Mincer regressions
$w(B, H)$	Relative wage of Black, high education	1.58	Mincer regressions
$w(W, H)$	Relative wage of White, high education	1.71	Mincer regressions
ψ	Housing supply elasticity	2.36	Saiz (2010)
m	Moving cost, money	0.0033	Bergman et. al. (2019)

Calibration: Internal Parameters and Target Moments

Parameter	Description	Value	Moment	Data	Model
Neighborhoods					
A_A	Amenity in A	1.00	Population neighborhood A	0.17	0.17
A_B	Amenity in B	1.12	Population neighborhood B	0.62	0.62
A_C	Amenity in C	1.22	Population neighborhood C	0.21	0.21
η_A	Housing supply in A	25.30	Rent neighborhood A	0.12	0.12
η_B	Housing supply in B	22.62	Rent neighborhood B	0.22	0.22
η_C	Housing supply in C	1.41	Rent neighborhood C	0.45	0.45
κ	Shape parameter for location	0.13	Neighborhood flows	0.35	0.41
m^B	Migration cost for Black HHs	0.06	Difference in moving prob for Black HHs	-0.06	-0.06

▷ Details: flows ▷ Policy functions

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Amenities: Importance of bliss point					
φ_W	White	0.65	Migration response to Black share, Black non-college	0.02	0.04
φ_B	Black	1.04	Migration response to Black share, Black college	0.03	0.04
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Skill					
θ_c	Constant term	0.56	Mean skills	1.00	1.22
θ_a	Ability	0.55	Regression coefficient of education on skills	0.19	0.19
θ_i	Investment	0.45	Covariance (s, i)	0.16	0.22
θ_X	Spillovers	0.17	Ratio college share neighborhood C to A	3.53	3.39

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Ability					
ρ_a	Persistence ability	0.40	Regression coefficient of child on parent ability	0.51	0.51
σ_a	Std. dev. ability	1.19	R^2 child on parent ability	0.26	0.26
Education					
$\bar{c}$	Education cost level	2.11	Educational probability	0.42	0.42
σ	Shape parameter education	0.41	R^2 education choice	0.16	0.15

▷ Details: flows ▷ Policy functions

Model Validation 1: Moving to Opportunity

Data: MTO

- Voucher program increased college attainment (Chetty et al., 2016)
- Small-scale RCT

Model:

- Subsidize rent differences across neighborhoods for households living in A
- Partial equilibrium exercise, following the small-scale RCT

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	Data	Model
Takeup rate (%)	[46.0, 49.3]	31.0
College attainment, treatment-on-the-treated (%)	[2.9, 7.6]	4.1
College attainment, intent-to-treat (%)	[1.4, 3.7]	1.3

Model Validation 2: Causal effect of segregation

Data: (Ananat, 2011)

- Instrument: exogenous variation in segregation from the historical layout of train tracks
- Measure the causal impact of segregation on college attainment

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Model:

- Eliminate amenity externality, evaluate the response in college attainment
- Compare general equilibrium

	Data	Model
Δ college attainment, White	[-0.29, 0.012]	0.0791
Δ college attainment, Black	[-0.52, -0.078]	-0.2108

Model: Segregation and College Gap

Model Explains Segregation and the College Gap

Model generates 80% of the college gap and the level of segregation

	Data	Model
College attainment		
All, %	0.42	0.42
White, %	0.47	0.47
Black, %	0.19	0.25
College gap, p.p.	0.28	0.22
Black share		
All	0.20	0.20
Neighborhood A	0.78	0.79
Neighborhood B	0.09	0.09
Neighborhood C	0.07	0.04
Dissimilarity Index	0.61	0.65

1. Wage gap:
Higher earnings enable White HH to afford better neighborhoods, invest in kids (Couture et al., 2023)

2. Amenity externalities:
Drives White HHs to C and Black HHs to A
Segregation $\Longrightarrow$ lower spillovers for Black $\Longrightarrow$ college gap

3. Mobility cost differences:
Reinforces these outcomes

$\rightarrow$ Racial inequality in exposure to high-quality neighborhoods

▷ Dissimilarity index

Neighborhood Heterogeneity Matters

- Three GE neighborhood variables: Spillovers (X_n), race shares ($S_{r,n}$), and rents (p_n)
- What would happen if these are determined at the city, instead of neighborhood, level?

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- What would happen if these are determined at the city, instead of neighborhood, level?

	College gap	Dissimilarity Index
Benchmark	0.22	0.65
Equal spillovers	0.08	0.57

- Equal spillovers $\Longrightarrow$ lower college gap, but still high segregation

Neighborhood Heterogeneity Matters

- Three GE neighborhood variables: Spillovers (X_n), race shares ($S_{r,n}$), and rents (p_n)
- What would happen if these are determined at the city, instead of neighborhood, level?

	College gap	Dissimilarity Index
Benchmark	0.22	0.65
Equal spillovers	0.08	0.57
Equal race shares	0.05	0.07
Equal rents	0.04	0.36
All equal	0.03	0.05

- Equal spillovers $\Longrightarrow$ lower college gap, but still high segregation
- Equal race shares or rents $\Longrightarrow$ lower segregation $\Longrightarrow$ lower college gap
- Neighborhood heterogeneities implies racial inequality in exposure to high-quality neighborhoods

Sources of College Gap: Wage Gap, Amenity Externality, Mobility Cost

No Wage Gap Counterfactual, $w(B, e) = w(W, e)$

	GE change in X_n	GE change in $S_{r,n}$	GE change in p_n	College gap	Dissimilarity index
Benchmark				0.22	0.65
General equilibrium	$\surd$	$\surd$	$\surd$	0.06	0.46

- Removing the Black-White wage gap decreases segregation by 29% and college gap by 16 p.p.

▷ Neighborhood comparisons

No Wage Gap Counterfactual, $w(B, e) = w(W, e)$

	GE change in X_n	GE change in $S_{r,n}$	GE change in p_n	College gap	Dissimilarity index
Benchmark				0.22	0.65
General equilibrium	$\surd$	$\surd$	$\surd$	0.06	0.46
Partial equilibrium	$\times$	$\times$	$\times$	0.17	0.60
No Δ spillovers	$\times$	$\surd$	$\surd$	0.16	0.61
No Δ race amenities	$\surd$	$\times$	$\surd$	0.13	0.59
No Δ rental price	$\surd$	$\surd$	$\times$	0.10	0.47

- Removing the Black-White wage gap decreases segregation by 29% and college gap by 16 p.p.
- Strong GE effects of change in spillovers for the college gap
- Improve local spillovers in A $\rightarrow$ lower racial inequality in exposure to high-quality neighborhoods
  $\rightarrow$ maintain segregation

▷ Neighborhood comparisons

Race-Blind Counterfactual: No Amenity Externality, $\varphi_b = \varphi_w = 0$

	GE change in X_n	GE change in $S_{r,n}$	GE change in p_n	College gap	Dissimilarity index
Benchmark				0.22	0.65
General equilibrium	$\surd$	$\surd$	$\surd$	0.05	0.07

- Removing amenity externality decreases segregation by 89% and college gap by 17 p.p.

Race-Blind Counterfactual: No Amenity Externality, $\varphi_b = \varphi_w = 0$

	GE change in X_n	GE change in $S_{r,n}$	GE change in p_n	College gap	Dissimilarity index
Benchmark				0.22	0.65
General equilibrium	$\surd$	$\surd$	$\surd$	0.05	0.07
Partial equilibrium	$\times$	$\times$	$\times$	0.06	0.07
No Δ spillovers	$\times$	$\surd$	$\surd$	0.05	0.07
No Δ race amenities	$\surd$	$\times$	$\surd$	0.05	0.07
No Δ rental price	$\surd$	$\surd$	$\times$	0.06	0.07

- Removing amenity externality decreases segregation by 89% and college gap by 17 p.p.
- GE effects are not important (in PE both Black and White households move)
- Changes in segregation affect the exposure to high-quality neighborhoods and the college gap
- Households move $\rightarrow$ lower racial inequality in exposure to high-quality neighborhoods

Equal Mobility Cost

	GE change in X_n	GE change in $S_{r,n}$	GE change in p_n	College gap	Dissimilarity index
Benchmark				0.22	0.65
General equilibrium	$\surd$	$\surd$	$\surd$	0.12	0.28

- Equalizing mobility costs decreases segregation by 57% and college gap by 10 p.p.

Equal Mobility Cost

	GE change in X_n	GE change in $S_{r,n}$	GE change in p_n	College gap	Dissimilarity index
Benchmark				0.22	0.65
General equilibrium	$\surd$	$\surd$	$\surd$	0.12	0.28
Partial equilibrium	$\times$	$\times$	$\times$	0.22	0.59
No Δ spillovers	$\times$	$\surd$	$\surd$	0.16	0.40
No Δ race amenities	$\surd$	$\times$	$\surd$	0.22	0.60
No Δ rental price	$\surd$	$\surd$	$\times$	0.15	0.37

- Equalizing mobility costs decreases segregation by 57% and college gap by 10 p.p.
- Strong GE effects (in PE only some Black households move)
- Changes in segregation affect the exposure to high-quality neighborhoods and the college gap
- Households move $\rightarrow$ lower racial inequality in exposure to high-quality neighborhoods

Intergenerational Mobility

	Education Probability			
	Benchmark	No wage gap	Race blind	Equal mobility cost
Non-college parent, White	0.32	0.30	0.29	0.28
Non-college parent, Black	0.17	0.26	0.25	0.20
Gap	0.14	0.04	0.04	0.08
College parent, White	0.64	0.63	0.61	0.61
College parent, Black	0.48	0.58	0.58	0.52
Gap	0.17	0.04	0.03	0.09

- Most of the reduction in the gap due to increase in college attainment for Black students

Multiple Equilibrium

Spillovers + Amenity Externality $\Longrightarrow$ Multiple Equilibrium

	Equilibrium 1	Equilibrium 2
Dissimilarity index	0.65	0.42
College gap	0.22	0.10
SSE	0.03	1.27

Equilibrium 1:

- Segregated equilibrium
- Matches the data

Equilibrium 2:

- Integrated equilibrium
- Lower college gap

Spillovers + Amenity Externality $\Longrightarrow$ Multiple Equilibrium

	Equilibrium 1	Equilibrium 2
Dissimilarity index	0.65	0.42
College gap	0.22	0.10
SSE	0.03	1.27

Equilibrium 1:

- Segregated equilibrium
- Matches the data

Equilibrium 2:

- Integrated equilibrium
- Lower college gap

Move from Segregated to Integrated Equilibrium, C.E, %	
Aggregate	6.4
Black	12.2
White	5.0
Non-college	13.1
College	-2.6
Black, non-college	14.7
Black, College	4.6
White, non-college	12.5
White, College	-3.6

- Aggregate gains
- Cross-sectional heterogeneity

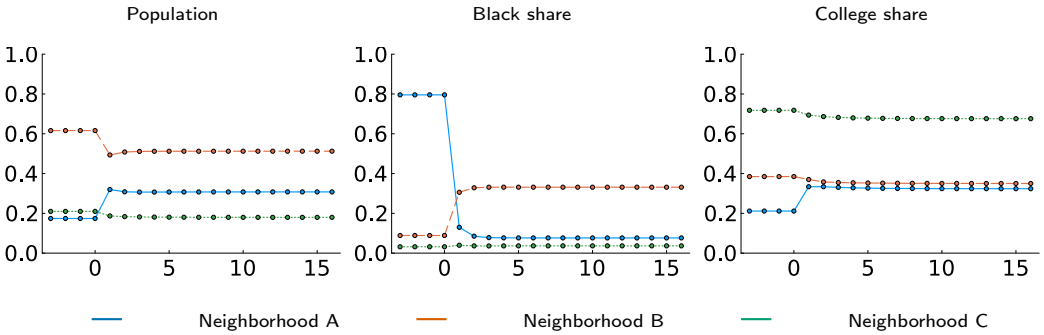
▷ Third equilibrium

Escaping the Segregation Trap

Can the economy coordinate to move from the segregated to the integrated equilibrium?

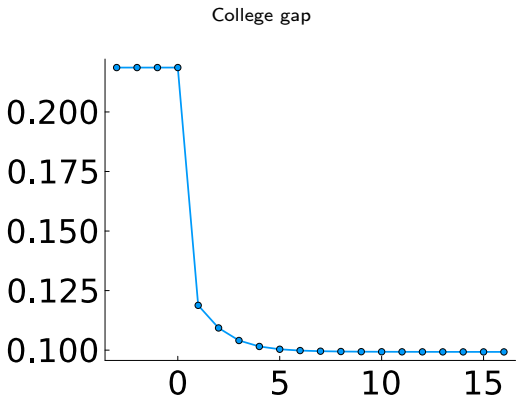
- Start in segregated equilibrium
- In $t = 0$ agents learn that in $t = \tau$ they will coordinate to be in integrated equilibrium
- What is the transition path?

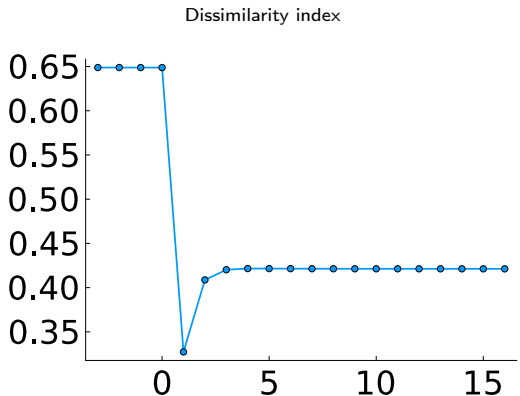
Escaping the Segregation Trap



- White households move from B to A
- Neighborhood C about the same
- Large increase in college share in A
- Fast coordination to equilibrium 2, robust for different values of τ

Escaping the Segregation Trap





- Lower racial inequality in exposure to high-quality neighbrohoods
- Lower college gap and segregation

Conclusion

Conclusion

- Add race to a benchmark model of a city with neighborhood spillovers
- Model does a good job in replicating the Black-White college gap and segregation
- Racial segregation affects the exposure to high-quality neighborhoods and the college gap
- Multiple equilibria
  - The data indicate that St. Louis is in the segregated equilibrium
  - Exists a second, more integrated equilibrium with a lower college gap
  - Economy can coordinate to live in a less segregated equilibrium

Appendices

Recursive Competitive Equilibrium

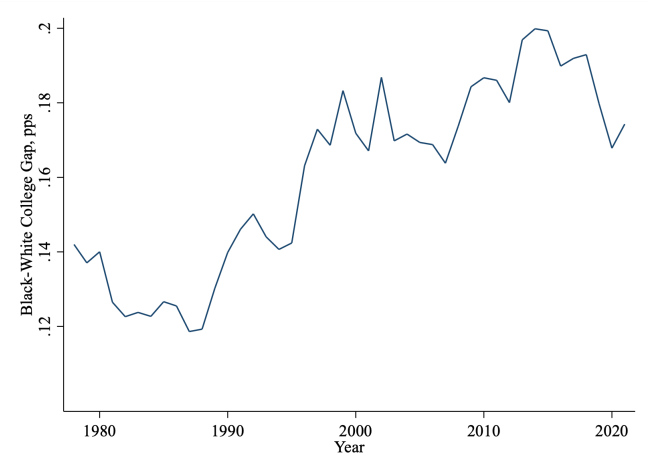
A *Recursive Competitive Equilibrium* is characterized by policy functions for the neighborhood choice $n(r, a, s, e, n_0)$, consumption $c(r, a, s, e, n_0, n)$, and investment $i(r, a, s, e, n_0, n)$ decisions of the parent, the education choice $e'(r, a, s, e, n)$ of the child, value functions $V(r, a, s, e, n_0, n)$, house prices $\{p_n\}_{n=1}^N$, local spillovers $\{X_n\}_{n=1}^N$, neighborhood racial shares $\{S_{r,n}\}_{n=1}^N \forall r \in \{B, W\}$, and an ergodic distribution $F(r, a, s, e, n_0, n)$ over race, ability, skills, education, birth neighborhood, and adult neighborhood, which satisfy the following:

1. Household optimization: the policy functions n, e', c, i solve both the adult's and child's problem.
2. Housing market clearing:
$$\eta_n p_n^{\psi} = S_n = \int F(dr, da, ds, de, dn_0, n) \qquad \forall\, n = 1, \ldots, N$$
3. Spillover consistency:
$$X_n = \frac{\int F(dr, da, ds, e^H, dn_0, n)}{\int F(dr, da, ds, de, dn_0, n)} \qquad \forall\, n = 1, \ldots, N$$
4. Location consistency:
$$S_{r,n} = \frac{\int F(r, da, ds, de, dn_0, n)}{\int F(dr, da, ds, de, dn_0, n)} \qquad \forall\, n = 1, \ldots, N \text{ and } r = \{b, w\}.$$

▷ Back

Data

Black-White College Attainment Gap



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Survey Evidence

Survey evidence from (Farley et al., 1997; Krysan and Farley, 2002)

	Attractiveness Ratings of Neighborhoods by Racial Composition (Black Respondents)
All Black	20%
Majority Black	23%
50% Black	50%
Majority White	5%
All White	2%

	Reasons Blacks Find A Neighborhood Most Attractive
Because it is mixed	56%
Positive effects of integration	22%
Better neighborhood characteristics	7%
White hostility	4%
Other	11%

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Survey Evidence

Krysan and Farley (2002)

TABLE 1: Attractiveness Ratings of Neighborhoods by Racial Composition and Rank Order (Black Respondents)

	First Choice Percent	Second Choice Percent	Third Choice Percent	Fourth Choice Percent	Fifth Choice Percent
All black	20	7	24	32	16
10 black–4 white	23	58	13	6	1
7 black–7 white	50	22	26	1	< 1
2 black–12 white	5	12	34	49	1
All white	2	2	3	12	81
Total	100	100	100	100	100
Sample size	2001	1995	1989	1977	1975

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Black-White Wage Gap Across Decades

	1980-1989	1990-1999	2000-2009	2010-2019
St. Louis, Below college				
White	1.000	1.000	1.000	1.000
Black	0.783	0.831	0.875	0.819
St. Louis, College or above				
White	1.281	1.567	1.632	1.817
Black	1.004	1.302	1.427	1.489
National, Below college				
White	1.000	1.000	1.000	1.000
Black	0.823	0.893	0.910	0.895
National, College or above				
White	1.446	1.704	1.802	1.988
Black	1.190	1.522	1.639	1.729

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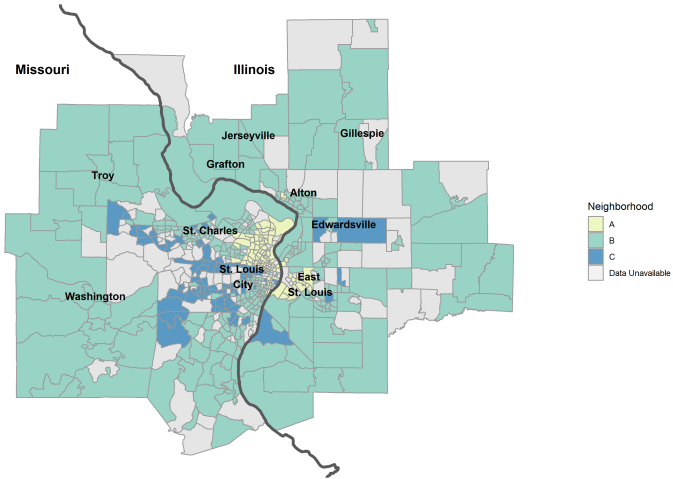
Neighborhood Segregation



Clusters:

A: Black & low-income

B: White & middle-income

C: White & high-income

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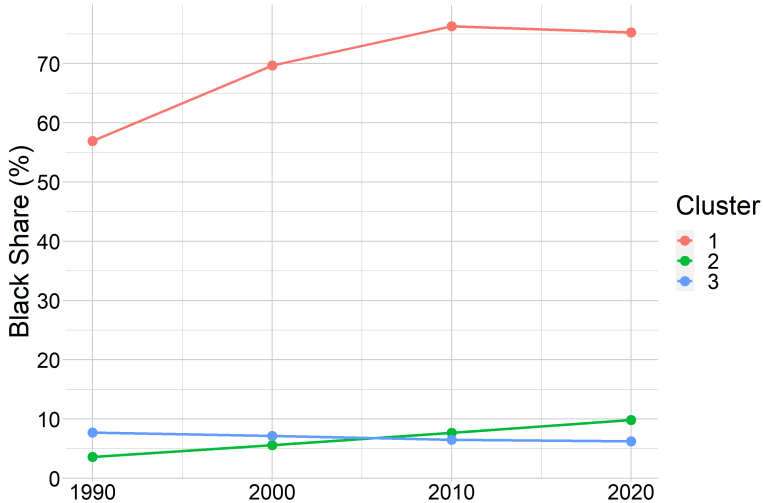
Black Share by Cluster Over Time



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Mobility Difference for Black Households

Dependent variable: indicator for parent neighborhood type $\neq$ child neighborhood type

	(1)
Childhood neighborhood type	
B	-0.328^{***}
	(0.026)
C	-0.188^{***}
	(0.029)
Log income	0.003
	(0.009)
Race	-0.061^{**}
	(0.028)
Constant	0.681^{***}
	(0.102)
N	3848
R^2	.047
FE for parents' education	✓

▷ Back

Neighborhood Flows

- Cluster Census tracts at the national level
  - K–means clustering algorithm on race share, income, housing prices, and college share
- NLSY: See county, race, education $\rightarrow$ estimate the probability of being in each cluster
- Compute the probability of moving between clusters between age 17 and 35.
- Conclusion: take a midpoint of 35% move across clusters

	Sample Restriction	
	50%	75%
Neighborhood flows	.461	.253
Observations	16,364	3,173

▷ Back

5. Skills and Education: New Version

Model:

$$\log s = \theta_s + \theta_i \log(i) + \theta_X \log(X_n) + \varepsilon$$

Map between model and data from NLSY-97 and Census:

Model	Data
s = skill	ASVAB score
i = investment	parental transfers
X_n = neighborhood college share	neighborhood college share

Target moments:

1. Estimate same regression in the data and model
2. Target to match coefficients on $\log(i)$ and $\log(X_n)$
3. Constant θ_s to match a mean skill of 1 (normalization)
4. Target the rank-rank correlation of income to discipline the variance of shock ε

▷ back

Dissimilarity Index

- Use dissimilarity index as in Ananat (2011)
- Dissimilarity index is defined as:

$$\text{seg} = \frac{1}{2}\sum_{i}^{N}\left|\frac{Black_i}{Black_{total}} - \frac{White_i}{White_{total}}\right|$$

  where N is the number of neighborhoods

- Measures (Ananat, 2011):

  "What percent of Blacks (or non-Blacks) would have to move to a different census tract in order for the proportion of Black households in each neighborhood to equal the proportion Black in the city as a whole?"

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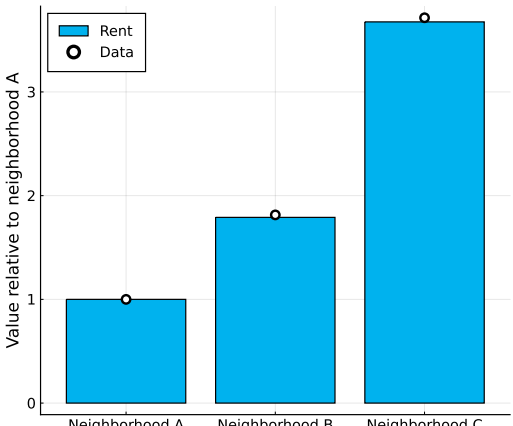
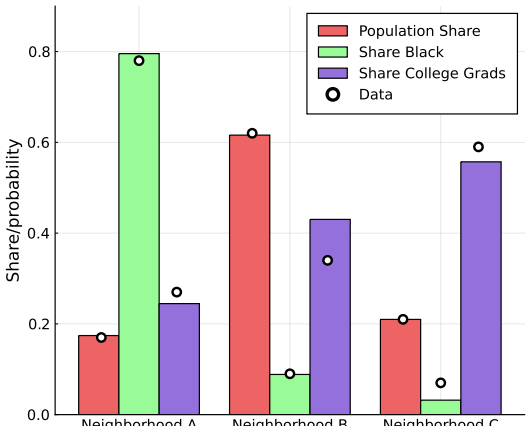
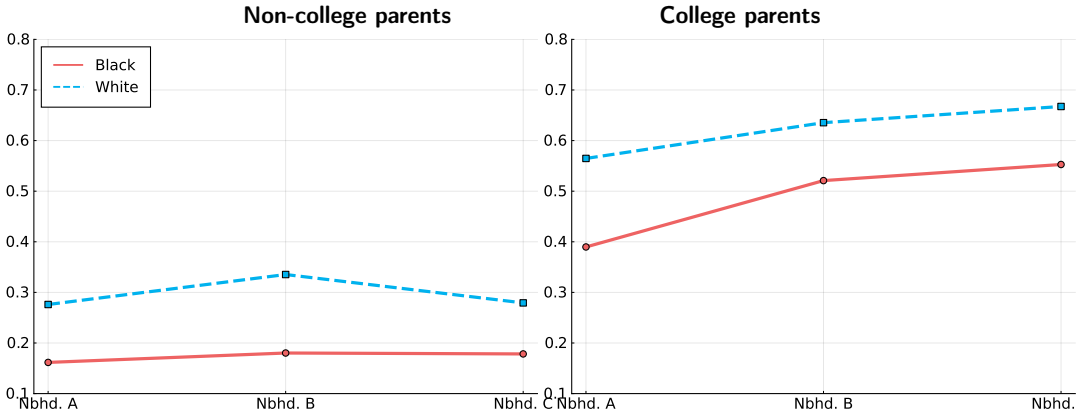
Quantitative Results

Baseline: Neighborhood Characteristics

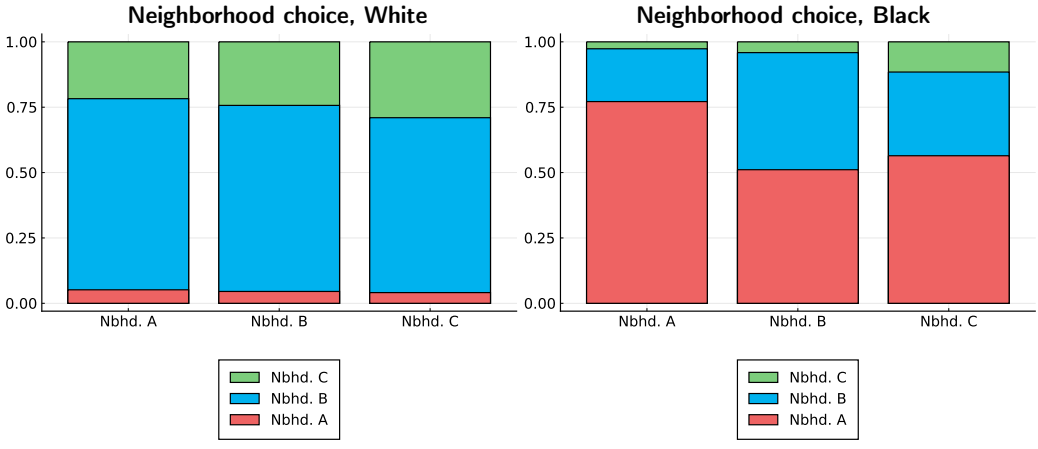




Benchmark: Probability of Going to College



Benchmark: Policy Rules, Neighborhood Choice



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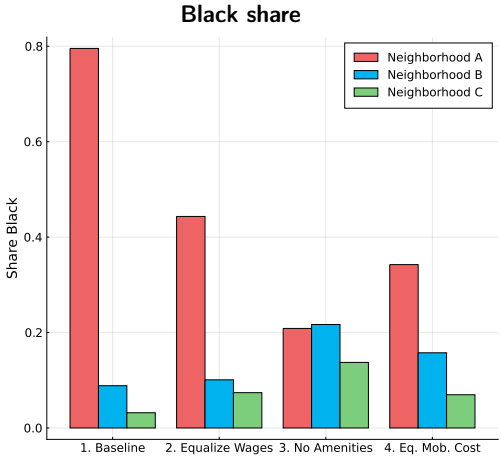
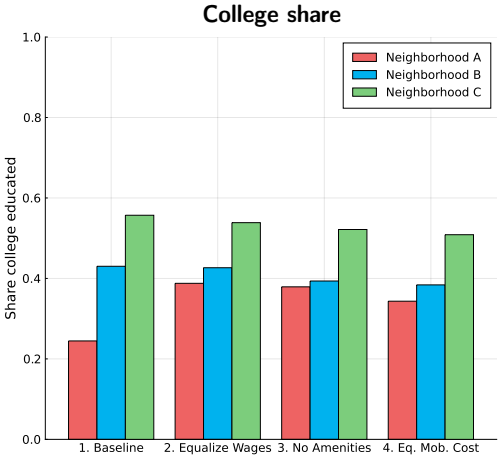
Neighborhood Characteristics Equalization





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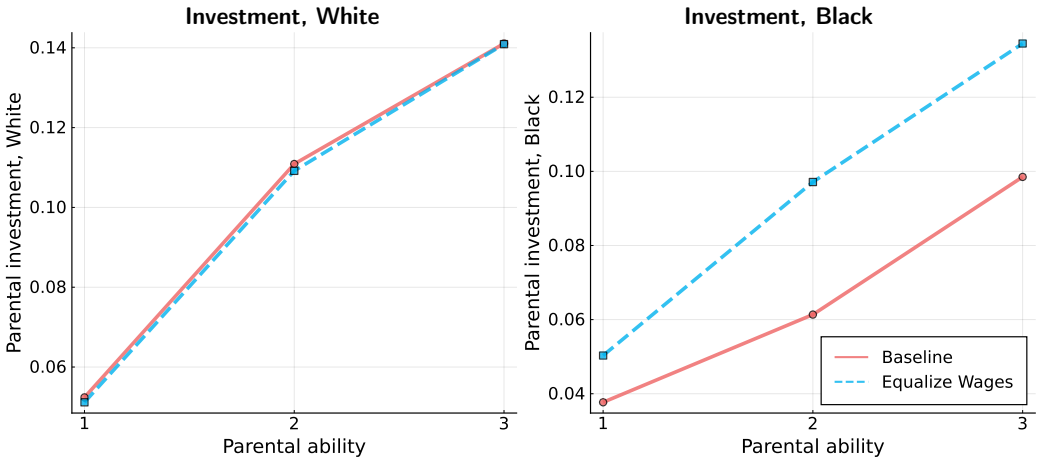
Equalizing Wages: Investment is the Primary Driver of the Closing Education Gap



Third Equilibrium

- Almost everyone lives in C (except a few moves due to the EV shocks)
- As a result, the racial composition of C is close to 80% white, 20% black
- The racial composition of A and B is close to 100
- The value of the amenities of both A and B are very low for White and Blacks.
- As a result, they choose to stay in C, justifying the equilibrium.
- In other words, the housing supply elasticity, which pin down rents, is not enough to make everyone living in C not that attractive.
- But living in C is too expensive, so they do not become educated (education probability 1% due to EV shocks)

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