The (Express)Way to Segregation: Evidence from Chicago

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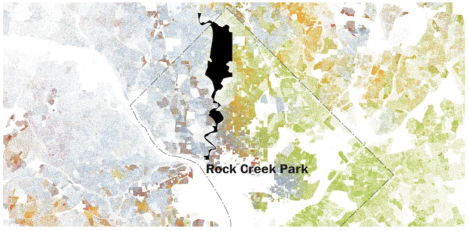
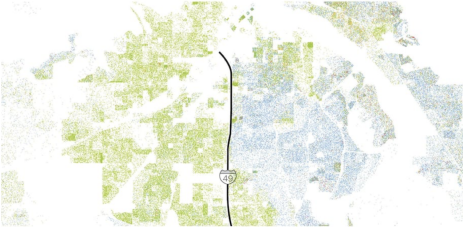
Lines of segregation

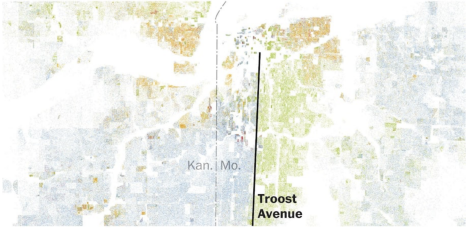
(a) Washington, D.C.



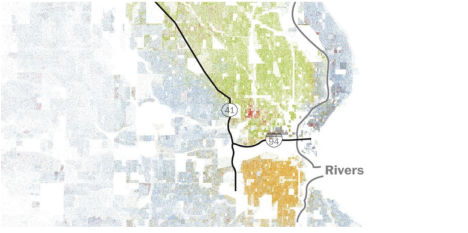
(b) Shreveport, La.



(c) Kansas City, Mo.



(d) Milwaukee, Wi.



1 dot = 1 person White Black Asian Hispanic Other

Source: The Washington Post, 2015 (2010 census data)

This project

How do man-made barriers affect residential racial segregation within cities?

Setting

- Impact of expressways in the neighborhoods of Chicago as a source of variation in quality and accessibility of locations (Example) (Related works)
- Reduced form evidence of impact of both features on racial segregation
- Urban model: estimate racial preference parameters; run counterfactuals
- Current public policies targeting issue of racial justice in transportation sector

Dan Ryan Expressway (Chicago, 1964)

Outline

1. Setting and data
2. Empirical analysis and main results
3. Theoretical framework (overview)
4. Conclusion

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Setting

Background

- 1956 Interstate Highway Act spurred expressway construction in the US
- Suburban sprawl 1950-1990 (Baum-Snow, 2007)
- Chicago: 22% drop in central population vs. 50% increase in metropolitan population
- First wave of Great Migration: 50,000 Black moved to Chicago from south (4.1%)
- Hispanic immigration boomed later: in 1960, 1.5% was Hispanic; in 1990, almost 20%

Data

- Census tract socio-demographic data (IPUMS, NHGIS)
- 1,511 consistent-boundary census tracts, 1950-2010 (following Lee and Lin, 2018)
- Data collected back to 1920 when available
- Transportation network data: 1940 and today road networks, historical railroad network

Maps Endogeneity

Outline

1. Setting and data
2. Empirical analysis and main results
4. Theoretical framework (overview)
4. Conclusion

Empirical analysis

Disamenity effect of expressways

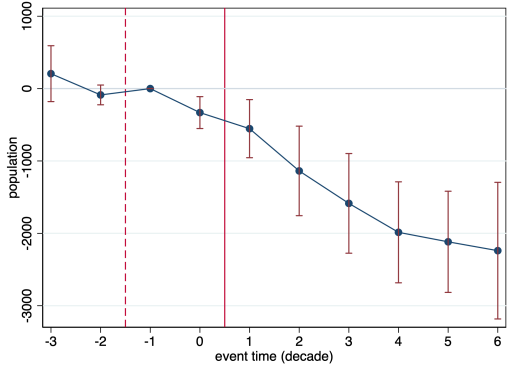
- Event-study
- Compare areas close to the expressway to those farther away
- Imply symmetric effects on the two sides

Barrier effect of expressways

- Long-difference 1950-1990
- Estimate the effect of changes in exposure to Black residents on change in racial composition of neighborhoods
- Measure of accessibility to Black residents (location-specific weighted average)

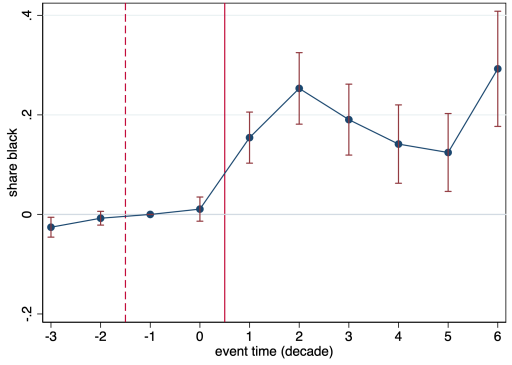
Residential population drops following expressways' construction

$$pop_{it} = \alpha_i + \gamma_t + \sum_{j=-3}^{6} \beta_j D_i \times T_{i,t=t^*+j} + \epsilon_{it}$$



Share Black goes up by 15 p.p. in first decade and by 20 p.p. after

$$shareblack_{it} = \alpha_i + \gamma_t + \sum_{j=-3}^{6} \beta_j D_i \times T_{i,t=t^*+j} + \epsilon_{it}$$



Raw means | No controls | No Black Belt | City only | Balanced panel | Weighted regression

$\leq 2km$ vs. $> 3km$ | $\leq 2km$ vs. $> 2km$ | $\leq 1km$ vs. $> 2km$

Empirical analysis

Disamenity effect of expressways

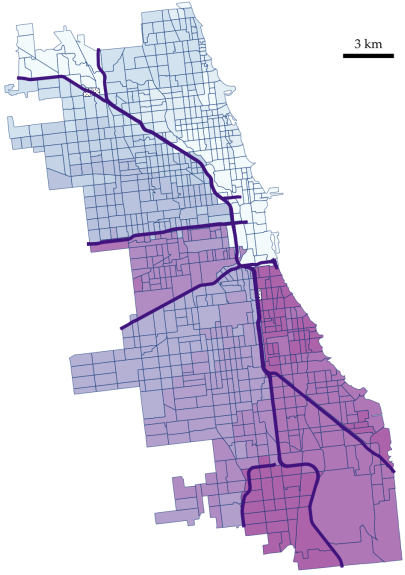
- Event-study
- Compare areas close to the expressway to those farther away
- Imply symmetric effects on the two sides

Barrier effect of expressways

- Long-difference 1950-1990
- Estimate the effect of changes in exposure to Black residents on change in racial composition of neighborhoods
- Measure of accessibility to Black residents (location-specific weighted average)

Measure of accessibility to Black residents (built network)

- Location-specific weighted average
- Constructed as:
  $\Delta S_i = \sum_{j \neq i} e^{-\rho \tau_{ij\ post}} s_{j\ post} - \sum_{j \neq i} e^{-\rho \tau_{ij\ pre}} s_{j\ pre}$
- Measures change in exposure to Black residents induced by both sorting and changes in transportation infrastructure
- Instrumented holding the racial distribution of races within the city fixed to the pre-period (IV)
- Instrument isolates variation in exposure to Black residents that is only due to changes in travel time between locations



Barrier effect of expressways

Estimating equation:

$$\Delta y_i = \beta_s \Delta S_i + \beta_d \mathit{Dist.\ expressway}_i + \mathit{Region\ FE} + \gamma_c' \mathit{Controls}_i + \epsilon_i$$

- $\Delta y_i = [\Delta \mathit{shareblack}_i, \Delta \mathit{landvalue}_i]$
- ΔS_i Change exposure to Black areas in the city
- $\mathit{Dist.\ expressway}_i$ (km) to control for disamenity of expressways
- $\mathit{Region\ FE}$ for being in north, south, west of city
- $\mathit{Controls}_i$ census tract and historical controls (added sequentially)
  - ΔY_i Change in exposure to "rich" areas in the city (proxied by college share)

Higher exposure to Black areas increases share Black residents

$$\Delta shareblack_i = \beta_s \Delta S_i + \beta_d Dist.\,expressway_i + Region\,FE + \gamma_c' Controls_i + \epsilon_i$$

	(1) OLS	(2) OLS	(3) IV All	(4) IV Subs 1	(5) IV Subs 2
ΔS (std)	0.331***	0.290***	0.176***	0.180***	0.224***
	(0.055)	(0.053)	(0.061)	(0.062)	(0.064)
Dist expressway (km)		-0.218***	-0.228***	-0.232***	-0.240***
		(0.021)	(0.021)	(0.022)	(0.023)
Observations	790	751	751	738	663
Adjusted R^2	0.154	0.438			
Region FE	Yes	Yes	Yes	Yes	Yes
Tract & Historical controls	No	Yes	Yes	Yes	Yes
F-stat			1631	1564	1324

Robust standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1

Tract controls: dist. to CBD, dist. to CBD sq, land area, dist. water; ΔY_i
Historical controls: dist. 1898 railroads, HOLC grade, 1920-1940 pop. density

Full table

...and decreases valuation of neighborhoods

$$\Delta landvalue_i = \beta_s \Delta S_i + \beta_d Dist.\,expressway_i + Region\,FE + \gamma_c' Controls_i + \epsilon_i$$

	(1) OLS	(2) OLS	(3) IV All	(4) IV Subs 1	(5) IV Subs 2
ΔS (std)	-0.252***	-0.211***	-0.131***	-0.171***	-0.142***
	(0.045)	(0.045)	(0.050)	(0.053)	(0.053)
Dist expressway (km)		0.086***	0.096***	0.093***	0.115***
		(0.023)	(0.023)	(0.023)	(0.022)
Observations	766	744	744	731	656
Adjusted R^2	0.256	0.523			
Region FE	Yes	Yes	Yes	Yes	Yes
Tract & Historical controls	No	Yes	Yes	Yes	Yes
F-stat			1886	1561	1250

Robust standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1

Tract controls: dist. to CBD, dist. to CBD sq, land area, dist. water; ΔY_i
Historical controls: dist. 1898 railroads, HOLC grade, 1920-1940 pop. density

Full table

Mechanisms

Sorting by income

- Expressways create disamenity, driving sorting by income
- On average, Black hh are poorer than white hh
- Black hh sort close to the expressways, white hh farther away

Sorting by race

- Expressways change exposure to different locations and hence to different races
- Households sort into areas that match their preferred racial composition
- Race responds strongly to higher exposure to Black areas, even controlling for changes in exposure to rich neighborhoods in the city

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1. Setting and data
2. Empirical analysis and main results
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Model setup

- Purposes: estimate homophily parameters and racial preferences spillovers; undertake counterfactual exercises
- Discrete choice model of residential location (AMM, 1962; Ahlfeldt et al., 2015)
  - Four types (2×2 race-by-education level), endowed with type-specific wage
  - Individuals work in the center of the city and commuting is costly
  - Choose location of residence and consumption of final good and floorspace to maximize utility
  - Expressways as source of variation in quality and accessibility of locations
  - Amenities depend on fundamentals, racial preferences, and disamenity of expressways
- Counterfactuals: quantify relative importance of disamenity vs. barrier effects; remove expressways in the city

Outline

Conclusion

- Role of urban structures in shaping the allocation of people within cities
- Expressways (i) as shock to relative amenities and (ii) as physical barriers
- Reduced form evidence of importance of dual nature of expressways when evaluating their impact on racial segregation
- Structural urban model to estimate homophily parameters and racial preferences spillovers; run counterfactual exercises
- Contribute to the debate targeting the social issues of transport infrastructures in US cities

Thank you!

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Appendix

East Garfield Park (West Side, Chicago)

(a) 1938

(b) 2020

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Related works

Effects of investments in transport infrastructure within cities

e.g., Baum-Snow (2007; 2020); Baum-Snow et al. (2017); Gonzales-Navarro and Turner (2018); Tsivanidis (2022); Heblich et al., (2020a); Brinkman and Lin (2022)

$\rightarrow$ Emphasize the role of expressways as urban barriers and show that this feature affects the spatial distribution of people within cities

Causes and consequences of residential segregation

e.g., Kain (1968); Cutler and Glaeser (1997); Cutler et al. (1999; 2008); Ananat (2011); Shertzer and Walsh (2019); Boustan (2010); Derenoncourt (2019); Chyn et al. (2022); Chetty et al. (2016; 2020); Athey et al. (2020)

$\rightarrow$ First long-run analysis of the causal effects of physical barriers on socio-economic disparities within cities

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Expressway construction (1951-2010) & 1951 Racial distribution

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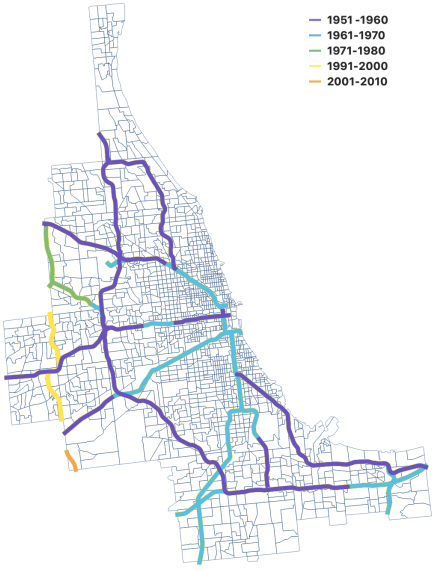
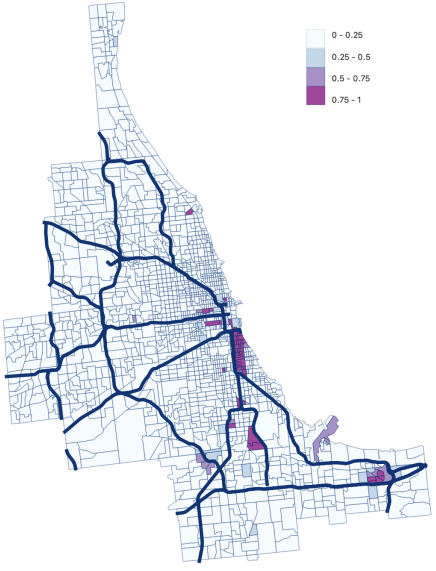


Expressway construction (1951-2010)



Share Black (1951)

Endogeneity of the network

- Previous work (Brinkman and Lin, 2022) show that central expressways were allocated to nhbs with high growth potential (and not to declining nhbs)
- In empirical strategy, lay out assumptions for identification to be valid
- Widely used IV techniques (Redding and Turner, 2015)
  Yellow book Straight lines 1909 Burnham plan IV results
- Robustness: Remove center/ex ante highly Black areas

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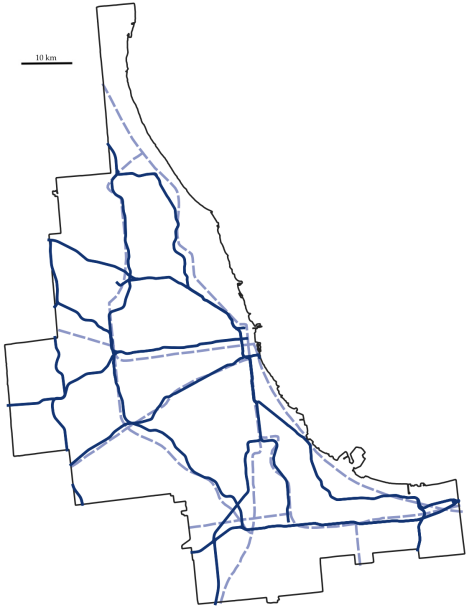
Yellow book instrument



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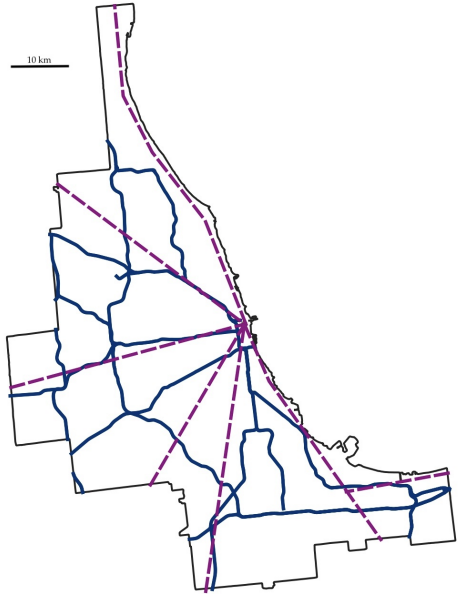
Straight lines instrument (targeted cities 1947 Highway Plan)



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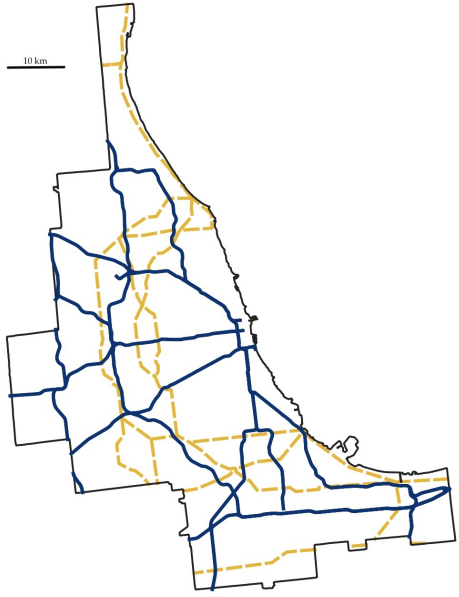
1909 Burnham Plan instrument (highway network)



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IV results (static instrument)

$$shareblack_{it} = \alpha_i + \gamma_t + \beta Dist.expressway_i \times Post_{it} + \epsilon_{it}$$

Dep. variable: Share black	(1) OLS	(2) OLS	(3) IV: Yellow book	(4) IV: Str line	(5) IV: Str line & Burnham
Dist exp (km)	-0.0105***	-0.0354***	-0.0637***	-0.0803***	-0.0304***
Adjusted R^2	0.6562	0.6872			
Observations	12,786	9,546	9,546	9,546	9,546
Tract FE	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes
Tract controls	No	Yes	Yes	Yes	Yes
F-stat			970.6	27.43	29.97

Standard errors clustered at tract level in parentheses
*** p<0.01, ** p<0.05, * p<0.1

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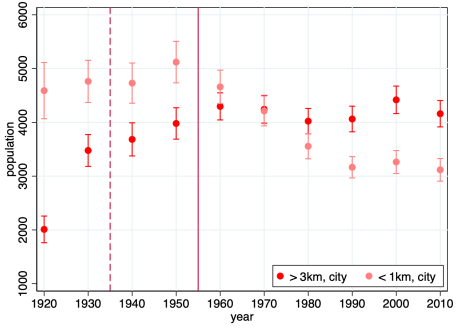
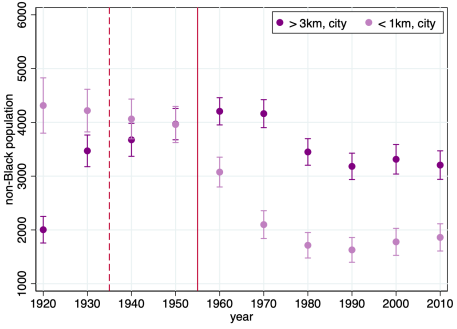
Totals, raw means (city only)



(a) Total population



(b) Total non-Black population

Note: The figures plot average residential populations in (eventually) treated vs. control areas over time from a binned regression. No controls added. The solid red vertical line separates pre-treatment from post-treatment periods.

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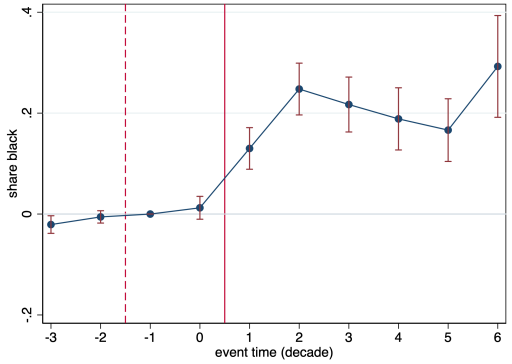
Outcome: Share Black; No controls



Note: The figure plots the regression coefficients from the two-way fixed effects estimator proposed by De Chaisemartin and d'Haultfœuille (2020). The dependent variable is share Black. No controls added. The solid red vertical line separates pre-treatment from post-treatment periods.

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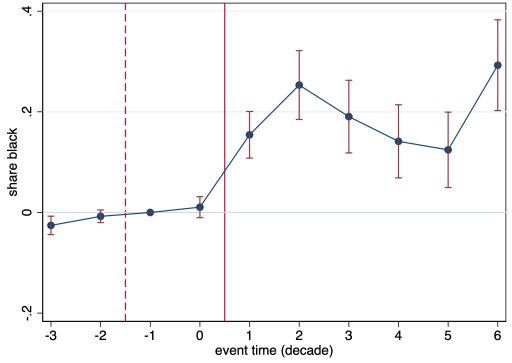
Outcome: Share Black; No Black Belt



Note: The figure plots the regression coefficients from the two-way fixed effects estimator proposed by De Chaisemartin and d'Haultfœuille (2020). The dependent variable is share Black. Full set of controls: (dist. to CBD, dist. to CBD sq, HOLC grade, city dummy, city $\times$ 1940 pop. density) $\times$ year FE. The sample excludes the area of the Black Belt. The solid red vertical line separates pre-treatment from post-treatment periods.

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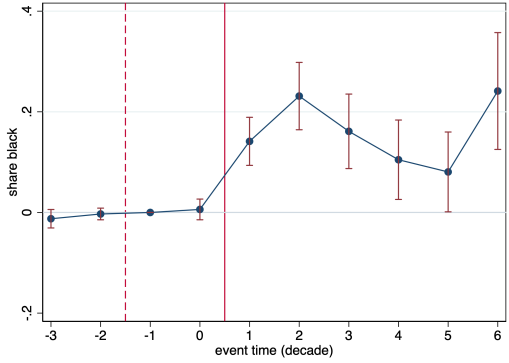
Outcome: Share Black; City only



Note: The figure plots the regression coefficients from the two-way fixed effects estimator proposed by De Chaisemartin and d'Haultfœuille (2020). The dependent variable is share Black. Full set of controls. The sample includes tracts within the boundaries of the City of Chicago only. The solid red vertical line separates pre-treatment from post-treatment periods.

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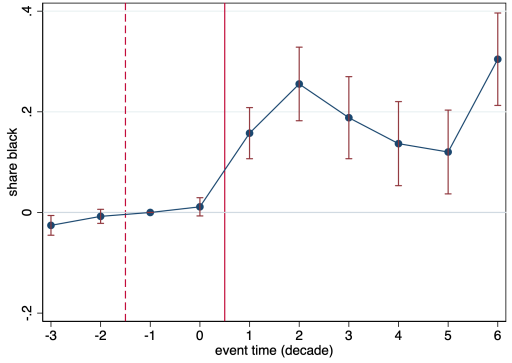
Outcome: Share Black; Balanced panel



Note: The figure plots the regression coefficients from the two-way fixed effects estimator proposed by De Chaisemartin and d'Haultfœuille (2020). The dependent variable is share Black. Full set of controls. The sample includes only census tracts fully observed between 1920-2010. The solid red vertical line separates pre-treatment from post-treatment periods.

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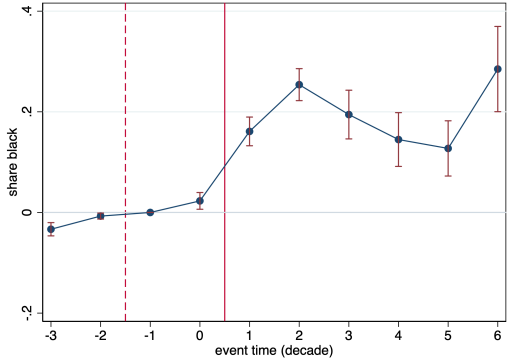
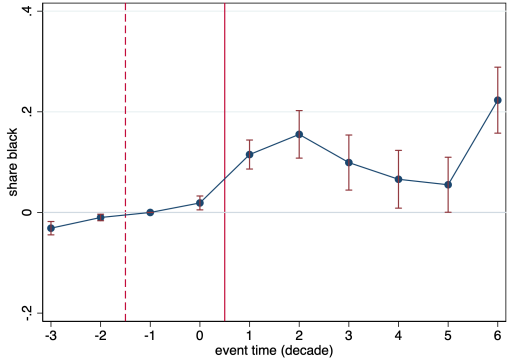
Outcome: Share Black; Bandwidth $\leq 2km$ vs. $> 3km$



Note: The figure plots the regression coefficients from the two-way fixed effects estimator proposed by De Chaisemartin and d'Haultfœuille (2020). The dependent variable is share Black. Full set of controls. Treated units are those within 2 km from the closest expressway; control units are those farther than 3 km away. The solid red vertical line separates pre-treatment from post-treatment periods.

Back

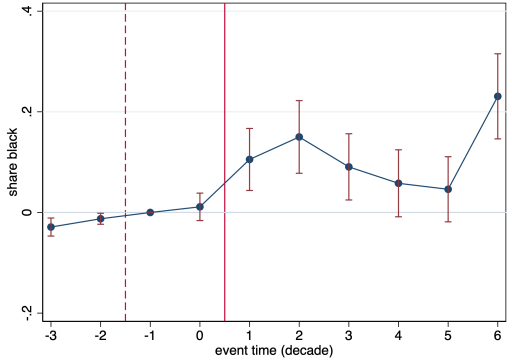
Outcome: Share Black; Bandwidth $\leq 2km$ vs. $> 2km$



Note: The figure plots the regression coefficients from the two-way fixed effects estimator proposed by De Chaisemartin and d'Haultfœuille (2020). The dependent variable is share Black. Full set of controls. Treated units are those within 2 km from the closest expressway; control units are those farther than 2 km away. The solid red vertical line separates pre-treatment from post-treatment periods.

Back

Outcome: Share Black; Bandwidth $\leq 1km$ vs. $> 2km$



Note: The figure plots the regression coefficients from the two-way fixed effects estimator proposed by De Chaisemartin and d'Haultfœuille (2020). The dependent variable is share Black. Full set of controls. Treated units are those within 1 km from the closest expressway; control units are those farther than 2 km away. The solid red vertical line separates pre-treatment from post-treatment periods.

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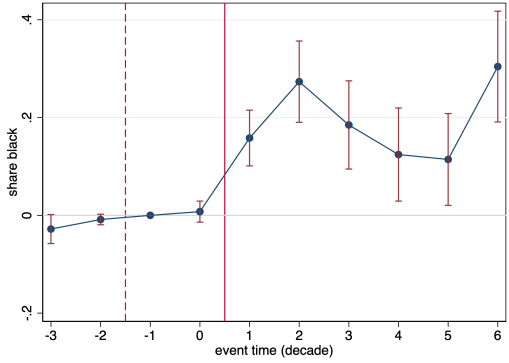
Outcome: Share Black; Weighted regression



Note: The figure plots the regression coefficients from the two-way fixed effects estimator proposed by De Chaisemartin and d'Haultfœuille (2020). The dependent variable is share Black. Full set of controls. Regression weighted by 1940 population. The solid red vertical line separates pre-treatment from post-treatment periods.

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ΔSMA_j

- Instrument for endogenous variable ΔS_j

$$\begin{aligned}\Delta S_j &= \sum_{j'} e^{-\rho \tau_{jj'post}} s_{j'post} - \sum_{j'} e^{-\rho \tau_{jj'pre}} s_{j'pre} \\ &= \sum_{j'} e^{-\rho \tau_{jj'post}} (s_{j'post} - s_{j'pre}) + \underbrace{\sum_{j'} s_{j'pre} (e^{-\rho \tau_{jj'post}} - e^{-\rho \tau_{jj'pre}})}_{\Delta SMA_j}\end{aligned}$$

- Borrowed from market access literature
- Hold racial composition fixed to initial values
- Isolates variation in accessibility to Black residents due only to changes in traveling times through expressways construction

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$$\Delta shareblack_i = \beta_s \Delta S_i + \beta_d Dist.expressway_i + Region\ FE + \gamma_c' Controls_i + \epsilon_i$$

	(1) OLS	(2) OLS	(3) OLS	(4) OLS	(5) OLS All	(6) Grid city se	(7) Conley se	(8) IV All	(9) IV Subs 1	(10) IV Subs 2	(11) IV Δ YMA
ΔS (std)	0.331***	0.333***	0.208***	0.276***	0.290***	0.290**	0.290***	0.176***	0.180***	0.224***	0.187***
	(0.055)	(0.054)	(0.054)	(0.050)	(0.053)	(0.113)	(0.107)	(0.061)	(0.062)	(0.064)	(0.060)
Dist expressway (km)		0.005	-0.190***	-0.219***	-0.218***	-0.218***	-0.218***	-0.228***	-0.232***	-0.240***	-0.228***
		(0.019)	(0.021)	(0.021)	(0.021)	(0.059)	(0.030)	(0.021)	(0.022)	(0.023)	(0.021)
ΔY (std)					0.074	0.074	0.074	0.045	0.057	-0.052	-0.006
					(0.049)	(0.108)	(0.094)	(0.049)	(0.051)	(0.057)	(0.056)
Observations	790	790	790	751	751	751	751	751	738	663	751
Adjusted R^2	0.154	0.153	0.347	0.438	0.438	0.438	0.438				
Region FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Tract controls	No	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Historical Controls	No	No	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
F-stat								1631	1564	1324	813.2

Back

$$\Delta landvalue_i = \beta_s \Delta S_i + \beta_d Dist.\,expressway_i + Region\,FE + \gamma_c' Controls_i + \epsilon_i$$

	(1) OLS	(2) OLS	(3) OLS	(4) OLS	(5) OLS All	(6) Grid city se	(7) Conley se	(8) IV All	(9) IV Subs 1	(10) IV Subs 2	(11) IV Δ YMA
ΔS (std)	-0.252***	-0.296***	-0.268***	-0.254***	-0.211***	-0.211*	-0.211**	-0.131***	-0.171***	-0.142***	-0.162***
	(0.045)	(0.045)	(0.049)	(0.047)	(0.045)	(0.110)	(0.086)	(0.050)	(0.053)	(0.053)	(0.050)
Dist expressway (km)		-0.126***	0.034	0.074***	0.086***	0.086	0.086*	0.096***	0.093***	0.115***	0.097***
		(0.024)	(0.027)	(0.024)	(0.023)	(0.067)	(0.048)	(0.023)	(0.023)	(0.022)	(0.023)
ΔY (std)					0.275***	0.275**	0.275***	0.295***	0.261***	0.427***	0.458***
					(0.061)	(0.111)	(0.102)	(0.059)	(0.062)	(0.056)	(0.067)
Observations	766	766	766	744	744	744	744	744	731	656	744
Adjusted R^2	0.256	0.290	0.404	0.506	0.523	0.523	0.522				
Region FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Tract controls	No	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Historical Controls	No	No	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
F-stat								1886	1561	1250	927.1

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