Expecting an Expressway

Jeffrey Brinkman Jeffrey Lin Kyle Mangum

Federal Reserve Bank of Philadelphia[a]

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[a]The views expressed in this presentation are solely those of the authors and do not necessarily reflect the views of the Federal Reserve Bank of Philadelphia or the Federal Reserve System.

Introduction

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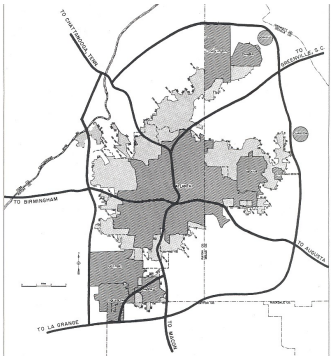
Do **self-fulfilling expectations** play a role?

- Costly moving → households care about current & future conditions.
- With spillovers, future conditions depend on others' choices.
- If everyone expects that a neighborhood will be attractive,
  → it attracts households today, **making expectations self-fulfilling**.

Challenges

- Expectations are hard to measure.
- Expectations may correlate with unobserved factors (including future outcomes).

Our approach: Historical planned highway segments in US central cities



Initial certainty of construction:

- Broad support, few constraints ca. **1956**.
- Early construction revealed disamenities: noise, pollution, barriers. Brinkman & Lin, 2024

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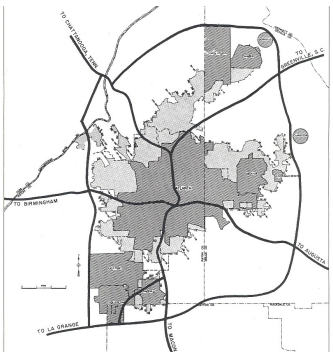

Initial certainty of construction:

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Then certain cancellation:

- Reforms post-**1973** → permanent cancellation of many segments. Expected disamenities never materialized.
- Which segments cancelled often depended on idiosyncratic factors (e.g., dependent segments).

What we do: Evidence and theory

Evidence: Expected-then-cancelled highways caused persistent decline in 40+ cities.

- Multiple identification strategies: matching, IV, runner-up design.

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Evidence: Expected-then-cancelled highways caused persistent decline in 40+ cities.

- Multiple identification strategies: matching, IV, runner-up design.

Theory: Temporary expectation shocks cause permanent change.

- Two key ingredients: Forward-looking households & Agglomeration economies.

→ Multiple possible steady states in neighborhood size.

→ Self-fulfilling expectations: Expected future decline triggers decline today.

→ Path dependence: Decline persists even when shock never materializes.

Contributions & implications

With strong enough spillovers, multiple steady states are possible.

Allen & Donaldson (2022), Bleakley & Lin (2012), Krugman (1991)

- We show when history doesn't determine structure—when "anything" can happen!

Contributions & implications

With strong enough spillovers, multiple steady states are possible.

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- We show when history doesn't determine structure—when "anything" can happen!

Expectations matter for local development policy.

- Policy makers can leverage expectations to solve coordination problems.

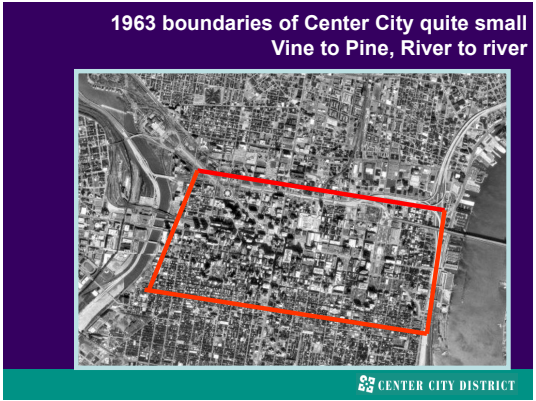
  Owens, Rossi-Hansberg, & Sarte (2020), Hornbeck & Keniston (2017)

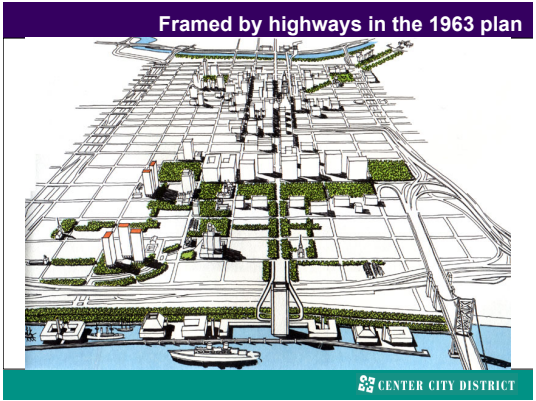
- Infrastructure plans affect spatial structure through expectations.

  Brinkman & Lin (2024), Duranton & Turner (2012), Baum-Snow (2007)

Case Study: Philadelphia's Crosstown Expressway

Philadelphia's planned expressway ring





credit: Paul Levy, *Philadelphia Center City District*, 2017

- Some were built. The Crosstown Expressway was not.

Philadelphia's planned expressway rings

The Philadelphia Inquirer

PUBLIC LEDGER

An Independent Newspaper for All the People

SUMMER SPECIALS In Your DAILY Inquirer "TOUR OF THE WEEK" Every Monday "WEEK-END TRAFFIC GUIDE" and "FISHING GUIDE" Every Friday

VOL. 239, NO. 55 SECTION B SUNDAY MORNING, AUGUST 24, 1958 TWENTY CENTS

Thieves Hack 12-Inch Wall, Steal $25,000 in Jewelry

Burglars Evade Alarm In Midcity

Map showing proposed new route for Delaware Expressway to meet objections of South Philadelphia interests. In new plan, Expressway would swing west over Lombard st. or Washington ave. (as shown in heavy dotted lines). Ramps would carry traffic from Expressway to Delaware and Pattison aves. Thin dotted line at right shows controversial route proposed by City Planning Commission.

S. Phila. Route Changes Proposed for Expressway

Chief Justices Of States Slap Supreme Court

Police Gasoline Cards Cost

State, Phila. Agree On Expressway Route

City Streets Commissioner David M. Smallwood told City Council's Budget Committee Wednesday that agreement had been reached with the State on the route of the first section of the proposed $100-million-dollar Crosstown Expressway between the Delaware Expressway and Philadelphia International Airport.

The first section, within the central city area, would run between Bainbridge and South sts. from 23d st. to the Delaware Expressway. Originally, it was planned to build stage one on a line with Lombard st. between the two rivers.

Smallwood said the route south to the Industrial Highway at the airport was still being studied. One proposal would route the new highway out Grays Ferry ave. across a new $4,750,000 bridge over the Schuylkill and south along the tracks of the Pennsylvania Railroad to a junction with the Industrial Highway.

Another would carry the highway out Baltimore ave. and then follow an undetermined course through West Philadelphia to the airport.

The proposed double-deck bridge over the Schuylkill at Grays Ferry ave. would replace the existing outmoded span. Construction is expected to start in 1962.

Smallwood also disclosed the present Spring Garden st. bridge over the Schuylkill would be replaced by a new structure costing $2,000,000. It would be built just south of the present bridge, forming a connection with the Schuylkill Expressway.

The Streets Commissioner termed a drop of 90 percent in parking meter thefts and vandalism in the past year "outstanding" and attributed part of the decline to installation of "pick proof" locks on some 5000 meters. He asked Council to appropriate $30,000 next year to purchase locks for the remaining 5000 meters, declaring that the cost would be more than offset in savings in a month or six weeks.

Deputy Streets Commissioner Richard A. Overmyer told the committee the policy of contracting with an outside firm for repair and maintenance of broken meters had worked so well, the department was considering putting the care of all meters under contract.

Smallwood asked the committee to increase the 1960 appropriation for collection of garbage to $855,000, an increase of $20,000 over the present year. He said the city was fortunate in having 96 percent of its garbage collected by farmer contractors, otherwise the cost would be prohibitive.

Overmyer said the demand for traffic lights was continuing and that the department could

Opposition from locals

Also triggered revolt against highways

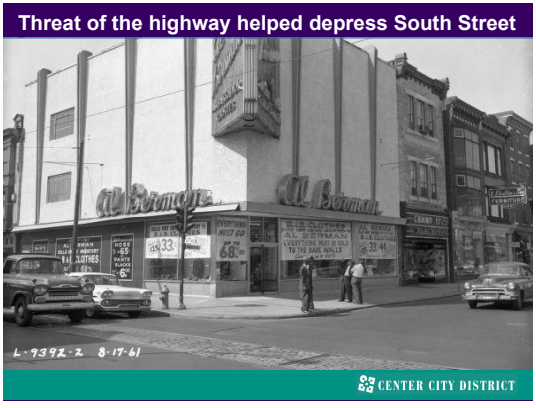
CENTER CITY DISTRICT

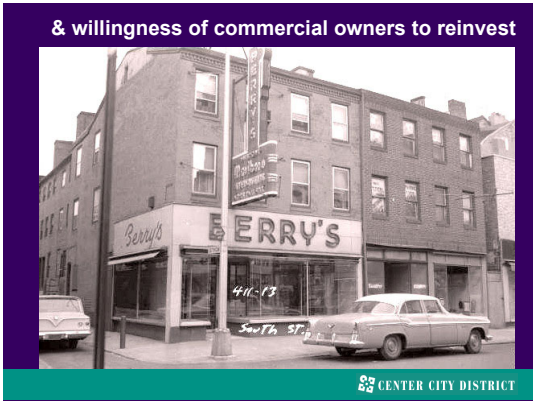
Organized protests, a sense of empowerment:
Preserving neighborhoods more important than building highways

CENTER CITY DISTRICT

credit: Paul Levy, *Philadelphia Center City District*, 2017

The threat of construction changed behavior





credit: Paul Levy, *Philadelphia Center City District*, 2017

Evidence from US central cities

Data and sample selection

- Balanced panel of consistent-boundary census tracts, 1940–2017. Lee & Lin, 2018
- Metro areas with digitized 1955 Yellow Book (YB) plans.
  - Neighborhoods that expected expressways.
- National Highway Planning Network
  - Neighborhoods that built expressways.
- Tracts with 5 miles of established city centers.
  - Consistent with net negative effects of highways. Brinkman & Lin, 2024

→ 4,000+ tracts in 40+ metros that have YB *and* 1940 tract data.

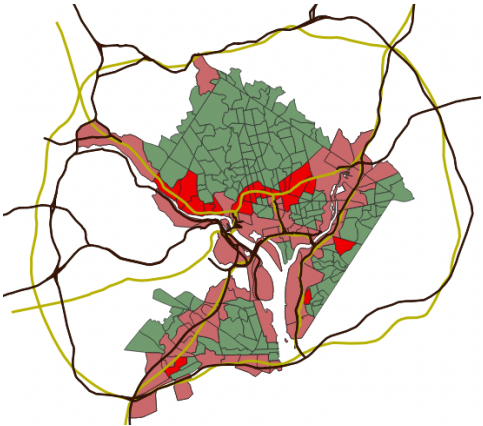
Treatment and comparison groups

B "Built" – Highway intersects tract.

PNB "Planned, Not Built" – Highway *plan* intersects tract, but not built.

NP "Not Planned" – Neither B nor PNB.

Washington DC



Note: Only tracts within 5 miles of downtown are in analysis sample.

Causal inference

Challenge: *Non-random* planning & construction of highways.

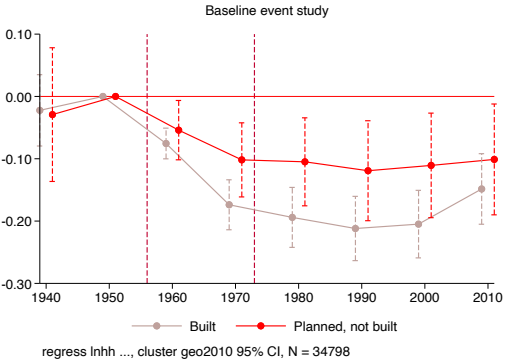
- *Negative* selection on growth factors into plan.
- *Negative* selection on growth factors into cancellation, conditioned on plan.

Narrative evidence suggests *positive selection*. Brinkman & Lin, 2024

- Highways planned in nbhds expected to grow most.
- Cancellations typically in high-SES neighborhoods.
- Pre-highway growth rates are similar (and > 0); Reversal of fortune.

Household population over time

Event study estimates

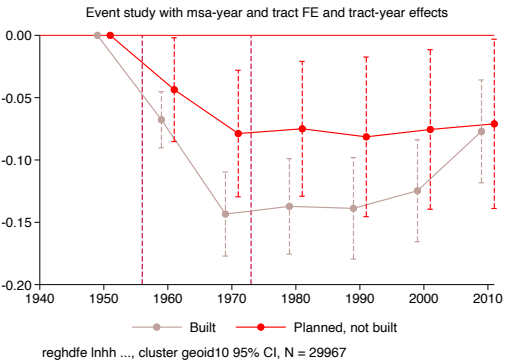


Differences in 1980:

	PNB vs NP	B vs NP
Simple contrast	-10.0%	-17.6%

- Pre-trends similar; reversal of fortune.
- Decline persists after 1973, despite cancellations.

Event study estimates with FE, natural & historical controls



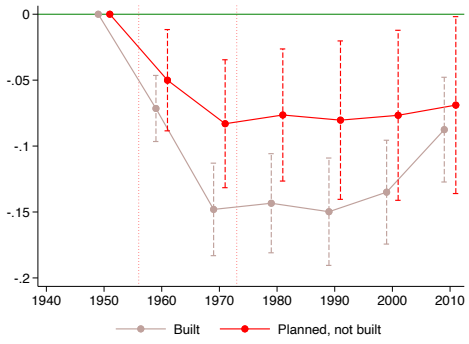
Differences in 1980:

	PNB vs NP	B vs NP
Simple contrast	-10.0%	-17.6%
Regression adjustment	-7.2%	-12.8%

Controls:

- Metro×Year FE
- Tract FE
- Tract natural & historical factors×Year effects (e.g., Year×flexible dummies for quantiles of proximity to river, to city center, slope, land area, 1940/1950 demographics)

Matching estimates



Differences in 1980:

	PNB vs NP	B vs NP
Simple contrast	-10.0%	-17.6%
Regression adjustment	-7.2%	-12.8%
Matching	-7.4%	-13.3%

Treatment factors: ⏩ IPWRA ⏩ overlap

- Tract natural factors (e.g., proximity to river, to city center, slope, land area) & pre-determined historical factors (1940/1950 demographics).

IV estimator

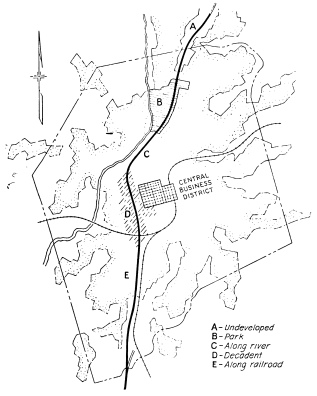
Remaining concern is that conditional ignorability of planning & cancellation is too strong an assumption.

- We need 2 instruments for 2 endogenous vars (B, PNB) or 2 endogenous margins:
  1. Selection into plan, and
  2. Selection into cancellation (conditioned on plan).
- We propose and use 2 types of IVs:
  - Historical rail and explorer routes [1]. ⏩ Duranton & Turner, 2012
  - 1947 **Inter**-city plan routes [1]. ⏩ Baum-Snow, 2007
  - Early and delayed distant connections [2] — These are new.

Early distant completions

Early, rural highway construction affected cancellation.

- Pre-1956 State routes were rural; no opposition.
- Which projects were started first often idiosyncratic; unrelated to central neighborhood factors. Johnson, 1965
- Design standards called for **rays** converging to CBD. →
- **Early distant completion** of rural rays (A) reduced likelihood that central rays (C) would be cancelled.
- On the other hand, **delayed distant completion** of rural rays increased likelihood of central-ray cancellation.

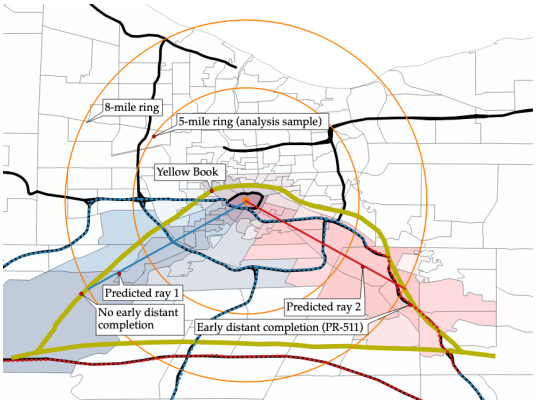


LOCATION OPPORTUNITIES FOR ARTERIAL HIGHWAYS AS RELATED TO LAND USE AND PHYSICAL CONTROLS

Figure B-6

Early distant completions — Example

- 8-mi ring defines 2 predicted rays.
- Rural portion of ray 2 completed 1955, predicts B | Plan.
- Rural portion of ray 1 *not* completed by 1956, predicts PNB | Plan.
- 19 cities have both early & delayed distant completions.

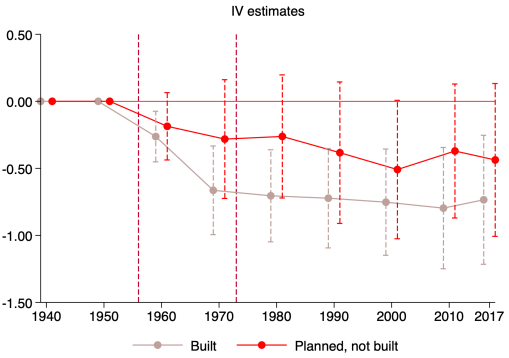


Rochester example

⏩ Toledo and Houston

IV estimates

"Early distant completions" - probability that expressway hooks up with existing outlying highway



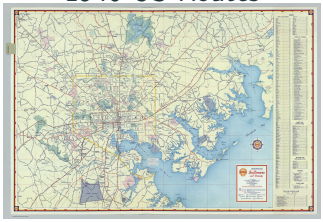
Differences in 1970:

	PNB vs NP	B vs NP
Simple contrast	-10.0%	-17.6%
Regression adjustment	-7.2%	-12.8%
Matching	-7.4%	-13.3%
IV	-23.0%	-50.6%

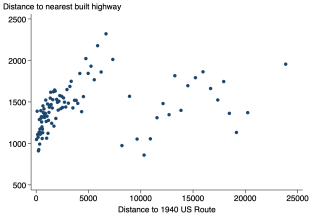
- 2-step IV estimator. Wooldridge, 2010
- Instrumentation is strong. ($F^B = 99$, $F^{PNB} = 46$)
- Larger IV estimates consistent with narrative, statistical evidence that highways planned & cancelled in neighborhoods expected to grow.

US Routes (In progress)

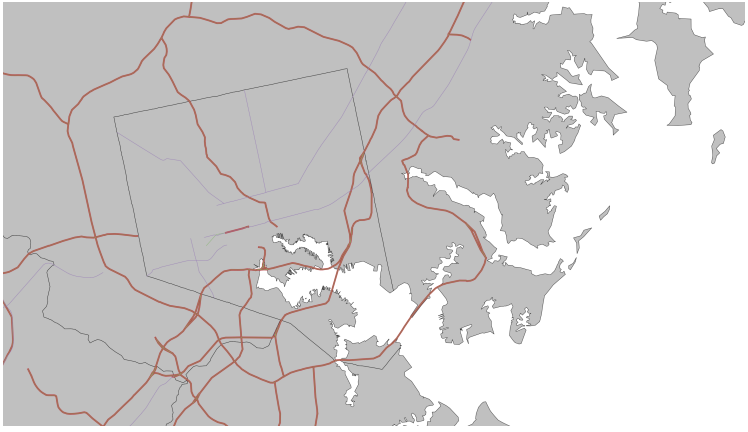
1940 US Routes



Non-monotonicity

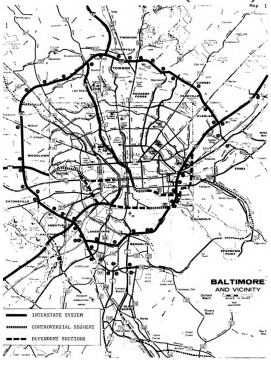


Comparison with built highways

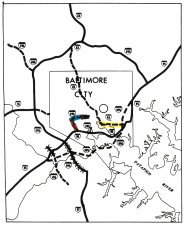


Plans from withdrawals and controversies (In progress)

Controversies (1970)



Substitutions (1968–)
& withdrawals (1974–1983)



- Increases sample from 41 to 51 cities.

Other outcomes, robustness, and extensions

Other outcomes:

- Population: Quantitatively similar results.
- Housing units: Substantial disinvestment in B & PNB n'hoods. ⏩
- Income, prices, and race: Modest net effects on sorting. ⏩ race ⏩ income

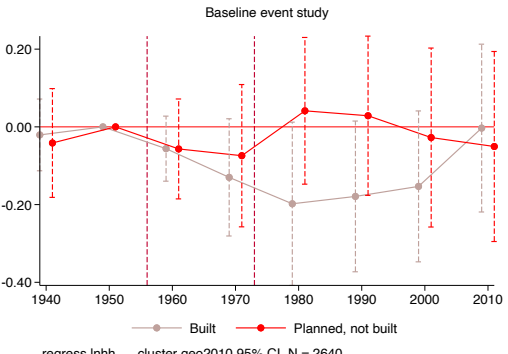
Robustness:

- Sample selection: 25% densest tracts in each city; >14k pop/mi^2; >4k HU/mi^2.
- Spatial treatment: Log distance to B & PNB vs. $1(\cdot)$. ⏩
- Matched runner-up (South Street vs Washington Ave) ⏩

Heterogeneity:

- Early cancellation has temporary effects (San Francisco, Baltimore).
- PNB effects only for initially high-density neighborhoods.

Early cancellation has temporary effects

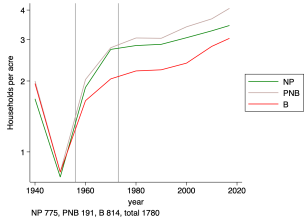


San Francisco and Baltimore were exceptional in that they had local control powers to stop highway construction.

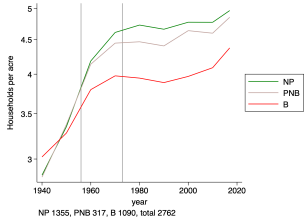
- SF had sole power to close roads; Board of Supervisors cancelled all highway construction in **1959**.
- Baltimore had sole authority to condemn properties.
- Differences in 1970 are similar, but PNB then returns to pre-highway levels.

Heterogeneity by initial density

Lower 1950 density (quartiles 1,2)

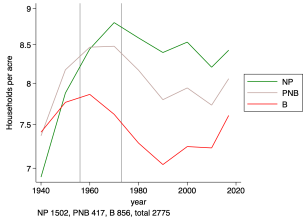


NP 775, PNB 191, B 814, total 1780



NP 1355, PNB 317, B 1090, total 2762

Higher 1950 density (quartiles 3,4)



NP 1502, PNB 417, B 856, total 2775

NP 1682, PNB 488, B 605, total 2775

- PNB vs NP contrast seen for initially high-density tracts only.

Summary of evidence

- Expected expressways caused significant **neighborhood decline**.
- Neighborhood decline persisted, even when construction was cancelled.
  - Except where planned highways were cancelled early.
  - Except for neighborhoods that were initially low-density in 1950.

Model

Model outline

Goal: Rationalize empirical patterns by characterizing utility *wrt* population density

- Empirical model that results in a DGP
  - Want to match to coarse data on pop. change in n'hoods at long differences
- Utility: Reduced-form repr. of net agglomeration forces
  - *Ex ante* agnostic about the sources and forms of spillover & congestion forces.
  - *Ex post* comparison with commonly used specifications.

Environment

- Households choose neighborhood in each period, subject to a move cost.
  - Expectations matter: Friction makes them care about (info. about) the future
- Value of nbhd j depends on exogenous amenities a_j and endogenous pop. p_j.
- Households choose location based on expected population $\hat{p}_{j\cdot}$, amenity LOM $f()$
- History matters: Choices determine realized population & next initial allocation.

How a location depends on others' choices

Utility can contain terms for negative and positive effects of neighborhood population

$$u(a_{j,t}, p_{j,t}) = a_{j,t} + \underbrace{u^{-}(p_{j,t})}_{\textit{congestion}} + \underbrace{u^{+}(p_{j,t})}_{\textit{agglomeration}}$$

We want do inference on the "net" shape of u.

How a location depends on others' choices

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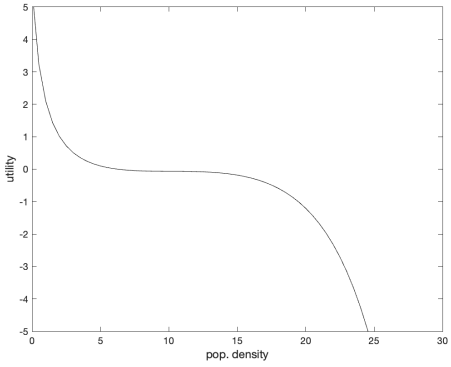
We want do inference on the "net" shape of u.

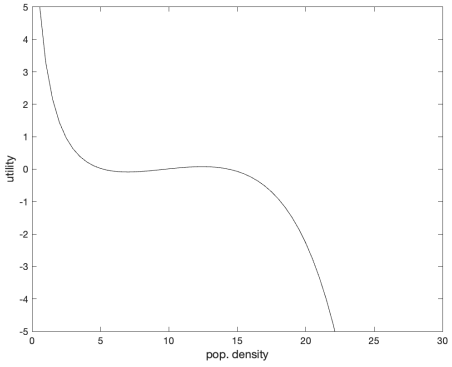
- Monotone congestion is when $u_p() < 0$ (for all p).
- Net agglomeration is when $u_p() > 0$ (over some support of p).
  $\rightarrow$ Can show that to get 2 steady states, $u_p() > 0$ over some support of p.

Shape of utility: 2 cases

Complete Congestion



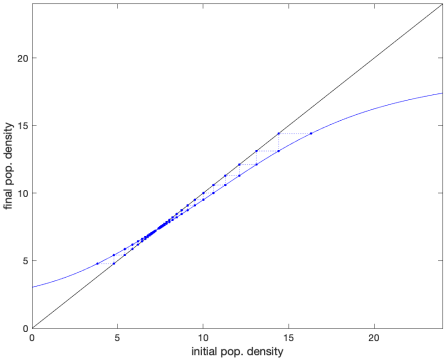
Some Agglomeration



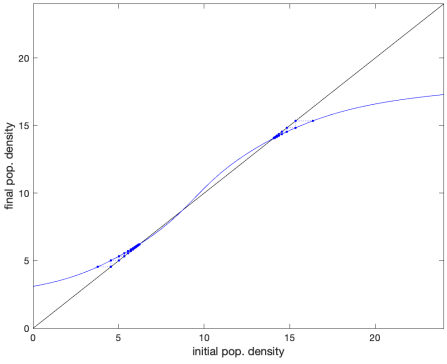
- Key ID Qs: Does utility slope upward? Over which range and how much?

Population dynamics: Toward steady-state(s)

Complete Congestion

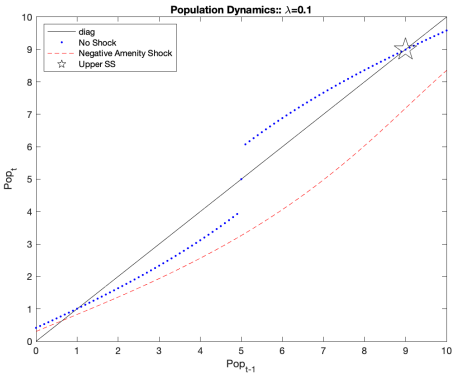


Some Agglomeration



- Agglomeration can yield multiple steady states.

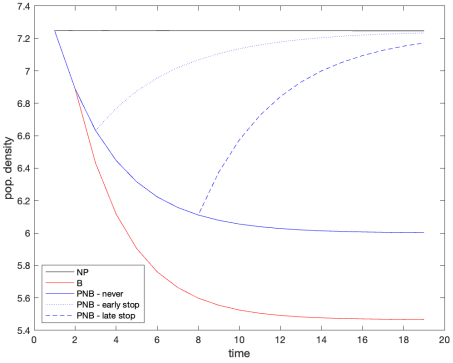
"Bad news" leads to neighborhood decline today



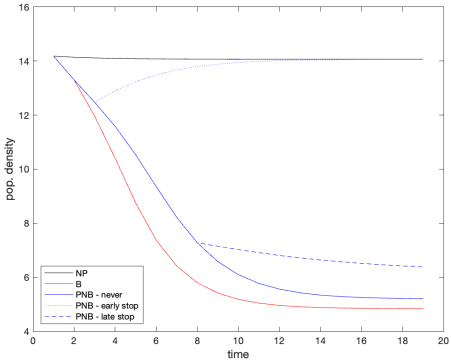
- "Bad news shock," eliminates steady state ★, leaving only one steady state.
- Self-fulfilling expectations: Nbhd declines immediately, transitioning to remaining (low) s/s.
- Path dependence: Nbhd doesn't recover, even after cancellation.

Population dynamics after PNB/B shock

Complete Congestion



Some Agglomeration

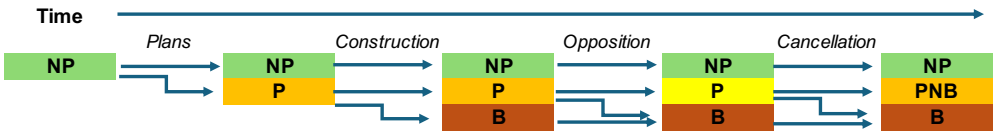


Nb. Effect size ordering: PNB < B.

Estimation

Simulated Histories

Highway regimes



Calibrated Outside Model

Some primitives

- Discount rate
- Move cost 1960 Census Tenure in Household
- Scale parameter in logit choice Gross mobility from 1950 SEAs

Expressway regime

- Highway penalty Brinkman & Lin, 2024
- Perceived highway probabilities by year (e.g., 0 before 1956, 1 by 1971)

Estimated Inside Model

- Shape of utility *wrt* p

$$u(p_j) = \alpha_0 + \alpha_1 p_j + \alpha_2 p_j^{\frac{1}{2}} + \alpha_3 p_j^{\frac{3}{2}}$$

  This permits (but does not require) 2 "turns" in the derivative

- Other amenity shocks: $AR(1)$ law of motion

$$a_t = \delta a_{t-1} + \epsilon$$

where $\epsilon \sim N(0, \sigma^2)$

Moment Conditions

1. Guess a parameter vector $\theta = (\delta, \sigma, \alpha_0, \alpha_1, \alpha_2, \alpha_3)$
2. Draw amenity shocks and highway arrival
3. Simulate a population history $\tilde{p}_{t,h}(\theta)_{t=0:T}$

- The model predicts change in population to compare with data,

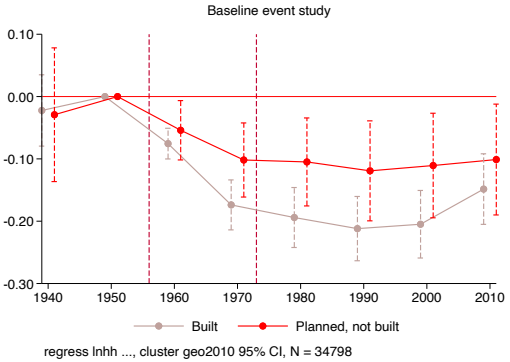
$$r_{t,h}(\theta) = [p_{t,h} - p_{t-10,h}] - [\tilde{p}_{t,h}(\theta) - \tilde{p}_{t-10,h}(\theta)]$$

- which we can aggregate by treatment arm

$$M(\theta) = \sum_t \sum_h r_{th}^2(\theta)$$

Matching the Data

Estimation via indirect inference



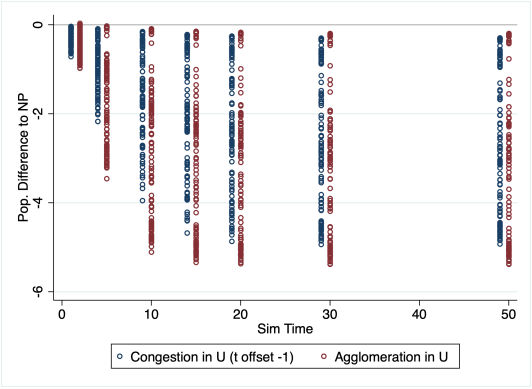
- What combination of parameters generates...
  ← this?

We can simulate data from different utility functions and run the event study regression from "reduced form" analysis:

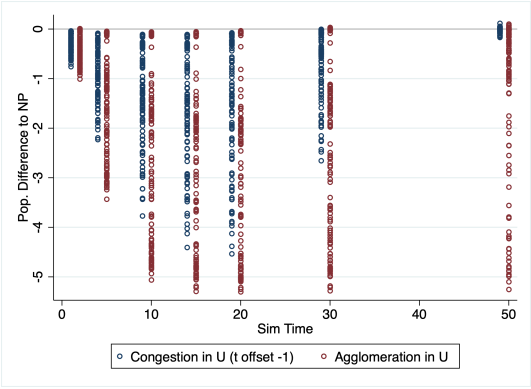
Estimation: distinguishing utility functions

Each dot a treatment-year mean outcome for a simulation outcome.

B



PNB



Divergence in treatment effect dynamics—**PNB** in particular—identifies utility function.

Conclusion

Summary

Expected-then-cancelled expressways led to persistent neighborhood decline.

- Big negative shock over nearly two decades
- Little uncertainty; Surprise cancellation.

A model with externalities and forward-looking households can rationalize this result.

- Expectations shock $\rightarrow \Delta$ equilibrium configuration $\rightarrow$ new steady state.

Appendix

Historical evidence on planned route selection

Routes were favored that:

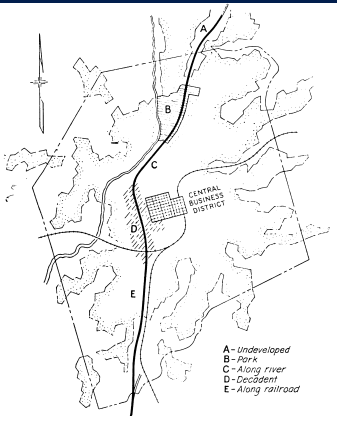
- Penetrated downtown or circumvented cities via beltway.
- Used undeveloped land.
- Linked to other modes such as rail stations and ports.
- Followed forecasted demand.
- Followed topography and physical features such as rivers.
- Were compatible with existing land use.
- National defense.

"Criteria for Selection of Interstate System Routes," testimony of CPR C.D. Curtiss, 4/15/1955. » Return

1957 AAHSO Red Book

"The improvement of radial highways in the past stimulated land development along them and often left *wedges of relatively unused land* between these ribbons of development. These undeveloped land areas may offer locations for new radials."

→ Planned routes likely to be *positively* selected on nbhd growth factors.



LOCATION OPPORTUNITIES FOR ARTERIAL HIGHWAYS AS RELATED TO LAND USE AND PHYSICAL CONTROLS

Figure B-6

Return

Historical evidence on canceled route selection

- vs. neighborhoods with built highways, nbhds with unbuilt YB plans:
  - More educational attainment in 1950.
  - Lower black share in 1950.
  - Higher population density in 1950.
  - Far from coastlines or rivers.

Brinkman & Lin, 2024

→? Conditioned on plan, canceled routes might have been *negatively* selected on neighborhood growth factors.

» Return

Matching estimator

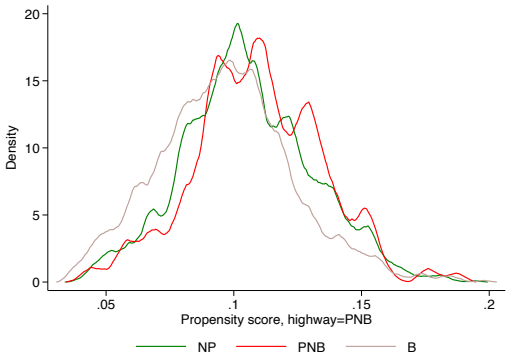
Inverse probability weighted regression adjustment Wooldridge, 2007; Cattaneo, 2010

- Estimator of multi-level treatment effects that combines matching and regression.
  (1) Estimate probability of treatment h conditioned on W.
  (2) Estimate treatment-level mean outcomes (conditioned on X) with inverse probability weights.
    - $\widehat{ATE}$ is contrast between predicted treatment-level means.
- Doubly-robust, if treatment model OR outcome model are correctly specified, then estimator is consistent.
  - IPWs magnify controls that look like treated (W) and vice versa.
  - RA accounts for differences in X across treated and control.

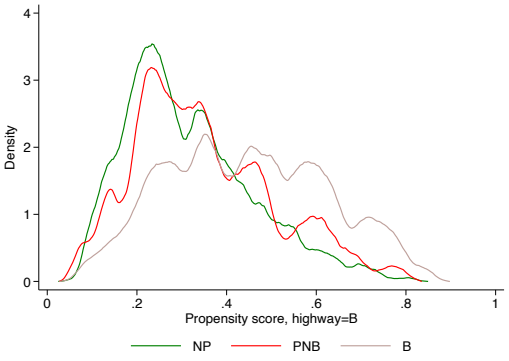
Return

Overlap

$\widehat{Pr(PNB)}$



$\widehat{Pr(B)}$



Return

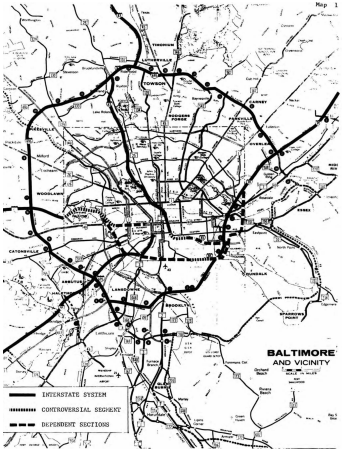
Dependent segments

In 1970, FHWA produced a report on controversial urban Interstate segments.

Report distinguished controversial vs *dependent* segments.

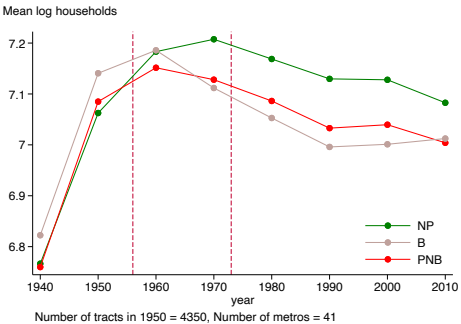
Dependent segments were not themselves controversial, but were likely to be cancelled if controversies were not resolved.

! Only 8 cities; mainly Baltimore, Boston, Cleveland, New York.



Baltimore controversies & dependent segments

Housing units



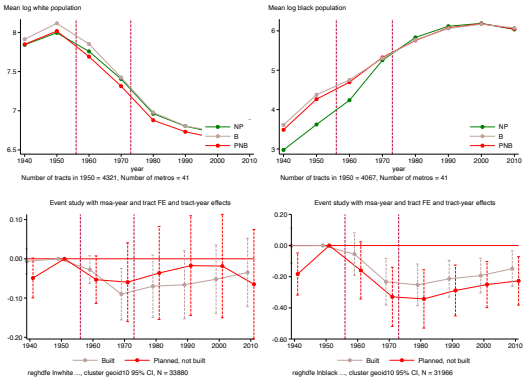
Evidence of substantial housing disinvestment.

- Housing units = occupied + vacant; i.e., "habitable."

Return

Race

- Large net population changes.
- Relative decline in both white and black pop in both B & PNB n'hoods.
- Net effect is modest and insignificant decline in nonwhite share.



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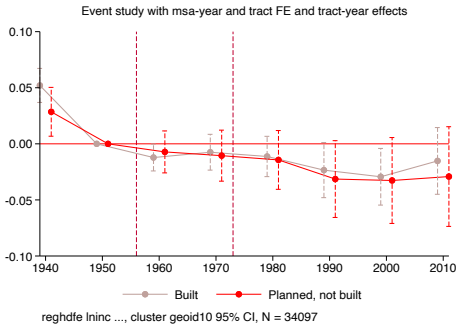
Income

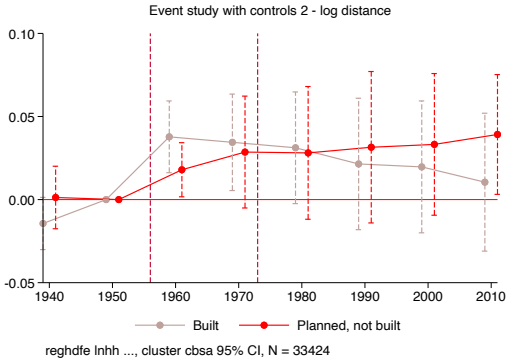


Modest and insignificant decline in income.

- Theory is ambiguous w/ multiple dimensions of heterogeneity.

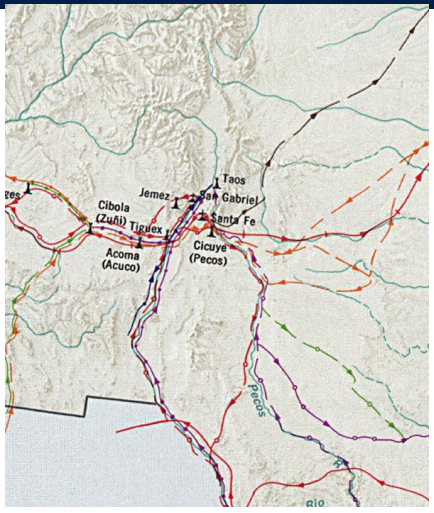
Return

Log distance treatment



Return

Historical routes



Pre-1675 explorer routes near Santa Fe, NM

Least-cost routes based on obsolete topography + history dependence. Duranton & Turner, 2012

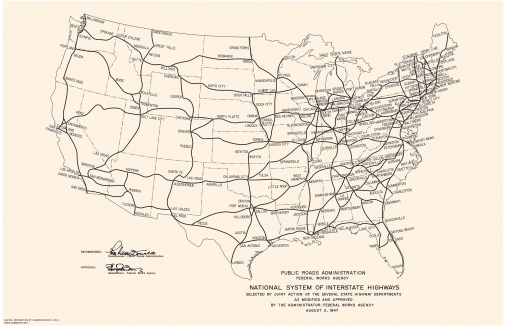
- Pre-1898 rail routes.
- 16th-19th c. explorer routes.

Return

Planned intercity routes

Planners connected distant cities for reasons of interregional trade and national defense unrelated to contemporary neighborhood factors. Baum-Snow, 2007

- 1947 intercity plan.
- Variant of 1947 intercity plan.



1947 intercity plan

Return

IV estimator

2-step IV estimator for binary endogenous treatments. Wooldridge, 2010; Xu, 2021

- Step 1. Estimate a binary response model (MNL) by maximum likelihood.
- Step 2. Use predicted values $\hat{B}, \hat{PNB}$ as excluded instruments in 2SLS.

Virtues:

- Usual 2SLS inference is asymptotically valid. Wooldridge, 2010
- Optimal feasible instrument if Step 1 correctly specified; Consistent even if incorrect. Wooldridge, 2010
- Nonlinear form improves efficiency and addresses weak instruments. Xu, 2021

Return

Early cancellation

San Francisco and Baltimore were exceptional in that they had (and used) local control powers to stop highway construction early on.

San Francisco

- CA State law gave power to close roads to local government
- SF Board of Supervisors had veto power over freeway system

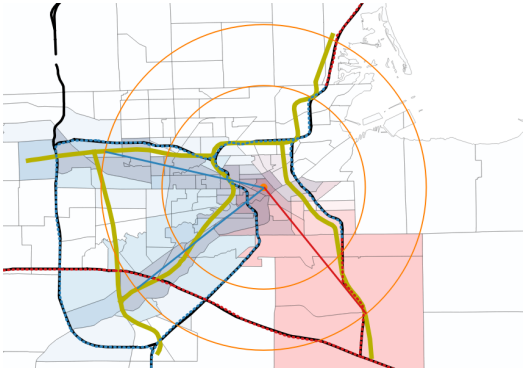
→ Board of Supervisors cancelled further highway construction in 1959

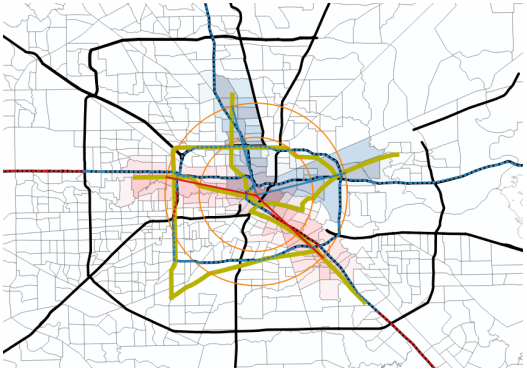
Baltimore

- Two unique provisions in city's home-rule charter
- City council had sole authority to condemn properties

→ City's planning commission could reject state highway plans

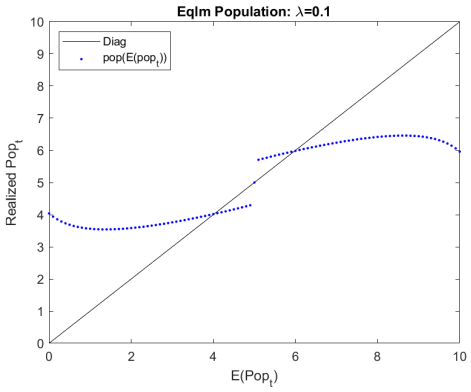
Early distant completions - Toledo and Houston examples





Return

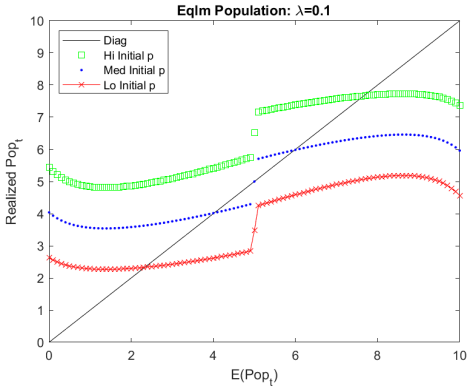
Equilibrium population



- Net agglomeration case: Upward-sloping utility (over some range).
- Equilibrium: realized = expected pop.
- There may be multiple equilibria.

Return

Equilibrium configurations depend on initial population allocations

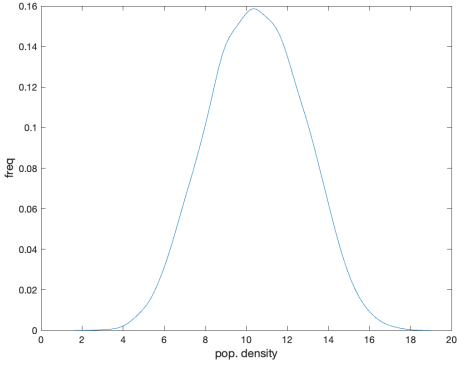


- Some initial conditions reach multiple equilibria; some have only one.

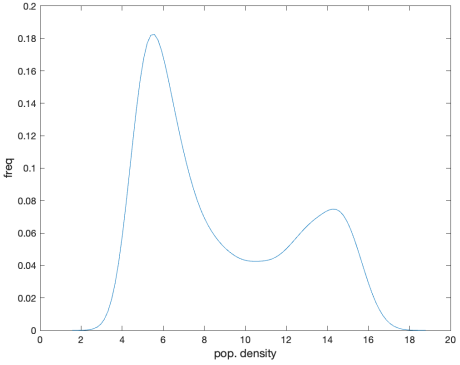
Return

Ergodic distribution of neighborhood size

Complete Congestion



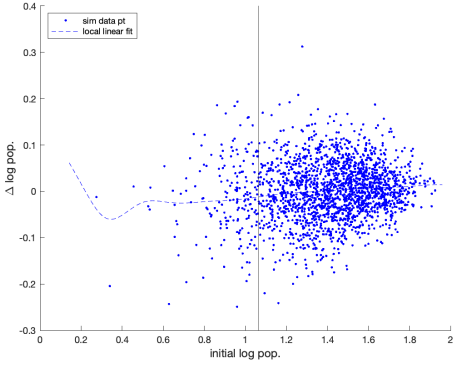
Some Agglomeration



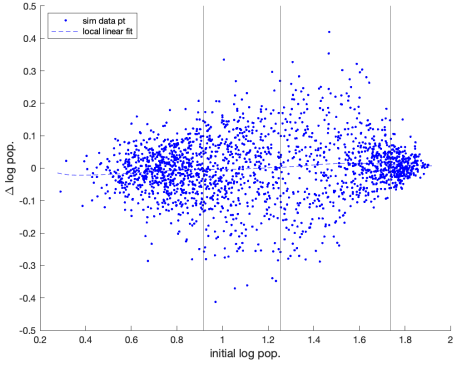
Return

Ergodic distribution of neighborhood population change (mean)

Complete Congestion

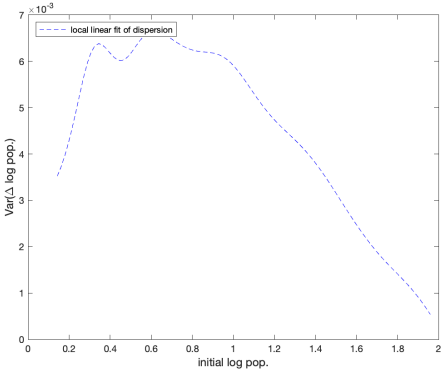


Some Agglomeration

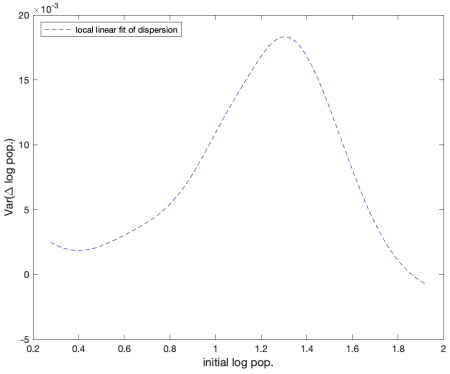


Ergodic distribution of neighborhood population change (variance)

Complete Congestion



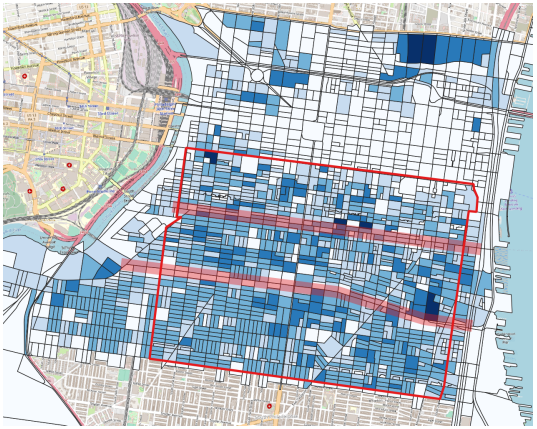
Some Agglomeration



Matched runner-up estimator

We test whether the announced highway depressed population along its corridor.

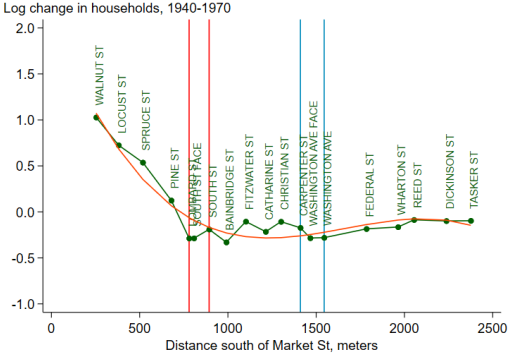
- 1910s: Early proposals for South Street alignment, Washington Ave runner-up alternative.
- 1947–1949: City approves and publicizes South Street alignment.
- 1964: First public hearing.
- 1973–1974: City, State abandon plans.

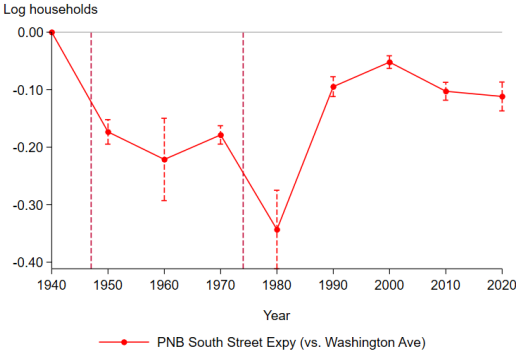


Sample area: Red box within Center City and South Philadelphia (Walnut–Tasker, 2nd–24th)
Map shows 1940 household population (blue) and South St,

Matched runner-up estimates

Return





Estimated effect of PNB:

- In 1970: -16.4%
- In 2020: -10.6%