

# Of Tracks and Trails: How Accessible Green Spaces Reshape Communities

Michelle Xiyue Li

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# Introduction

Access to green spaces has long been part of public awareness

## THE LUNGS OF THE CITY.

The effect of a park is purifying, energizing, yet calming on those who use it. Notice the people when they enter it; how their eyes lift from the pavement, and seek the tree-tops and the heavens, how their noses dilate as they pass a bed of hyacinths, how they straighten and breathe deep as the fresh air blows across the meadows, how the children romp and shout, how the ramblers smile and chatter, what relief the dreamer and idler seem to find in the quiet paths!

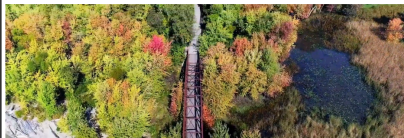
Charles M. Skinner, *New Century*; Aug 5, 1899

## *Stir-Crazy New Yorkers Discovered an Idyllic Spot. Will They Trample It?*

During the pandemic, people are venturing deeper into the city's forests, wetlands and grasslands, just as budget cuts threaten the spaces' upkeep.

Opinion  
**MEET US ON  
THE RAIL TRAIL**

A place to gather as Americans, not  
partisans.



The Island Line Trail on the Burlington, Vermont, waterfront, which Howard Dean played a role in creating. (Courtesy From Rails to Trails Film, LLC)

By Tommy Thompson and Howard Dean

# Access Correlates with SES Within Urban Environments



Figure: Variation in Greenness by Median Income (NYT)

# Motivation & Research Question

- Many jurisdictions are investing in green space development, frequently in formerly industrial areas
  - Valued by residents, but historically scarce in these neighborhoods
  - Evidence of health and social benefits (Astell-Burt et al., 2013, Giannico et al. 2024, Jennings & Bamkole, 2019)
  - Fulfill policy goals: climate resilience and community revitalization

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  - Evidence of health and social benefits (Astell-Burt et al., 2013, Giannico et al. 2024, Jennings & Bamkole, 2019)
  - Fulfill policy goals: climate resilience and community revitalization
- What are the impacts of urban greening on housing markets and the communities around them?

# Roadmap

1. Research Setting
2. Data
3. Dynamic Effects in Greater Boston
4. National Long Run Impacts
5. Conclusion

# Setting

- **Challenge:** Hard to separate cause and effect in urban greening
  - New green space often comes alongside other investments
    - ▶ e.g. schools, transit, redevelopment
- **Research setting:** Rail trails - linear parks built on abandoned rail

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(a) High Line, 2000



(b) High Line, 2013

# Example: Abandoned Rail & Trail Distribution in Boston



Minuteman Trail



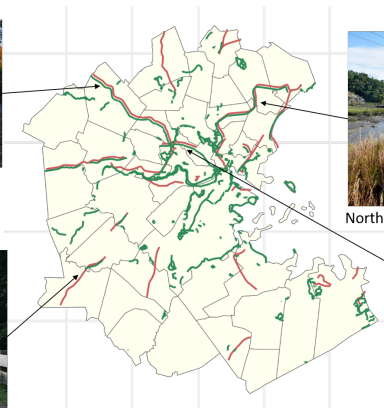
Northern Strand Community Trail



Bay Colony Rail Trail



Somerville Community Path

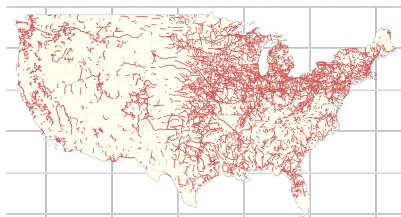


— Abandoned Rail — Multi-Use Trail

**Figure:** Abandoned Rail and Multi-Use Trails in Greater Boston

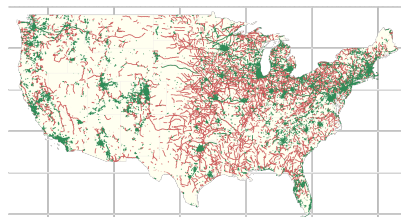
# Distribution of Rails and Trails Across the United States

- 26,000+ miles of rail trails in the U.S., in all 50 states
- 9,000+ miles currently under development [▶ Trail Facts](#)
- 100,000+ miles of abandoned rail [▶ Rail Facts](#)



— Abandoned Rail

(a) Abandoned Rail



— Abandoned Rail — Multi-Use Trail

(b) Abandoned Rail and Multi-Use Trails

# This Paper: Impacts of Urban Greening

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- I study how rail trails shape housing markets and neighborhoods
- Link new rail & trail datasets with census data in the contiguous U.S.
- Dynamic effects in Boston:
  - Track decade-by-decade neighborhood change around trail openings
- Long run national analysis:
  - Evaluate whether Boston's long-run impacts generalize nationwide

# Main Findings

- Housing values rise substantially near rail trails
  - Boston: 7% increase in the first decade, growing to 23% over time
  - Nationwide: 18% higher growth over the long run

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- Housing values rise substantially near rail trails
  - Boston: 7% increase in the first decade, growing to 23% over time
  - Nationwide: 18% higher growth over the long run
- Neighborhoods become higher-income and more educated
  - Changes unfold gradually over decades
- **Bottom line:** Rail trails are catalysts for urban revitalization, setting in motion self-reinforcing sorting and neighborhood change

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- 2. Data**
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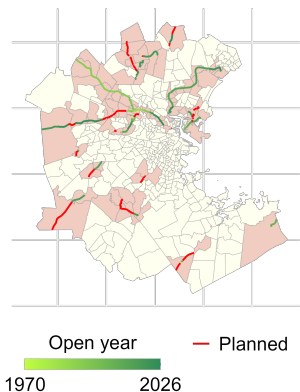
## Data

Source	Boston	National
<b>Abandoned Rail:</b> Forgotten Lands, Places, and Transit <ul style="list-style-type: none"> <li>Near universe of abandoned rail data in the U.S.</li> </ul>	✓	✓
<b>Active Rail:</b> Federal Railroad Administration <ul style="list-style-type: none"> <li>North American Rail Network</li> </ul>		✓
<b>Massachusetts Rail Trails:</b> MassDOT <ul style="list-style-type: none"> <li>Publicly available existing/planned multi-use trail data</li> <li>I identify rail trails based on which trails follow rail</li> <li>I research opening dates by segment</li> </ul>	✓	
<b>National Rail Trail:</b> OpenStreetMap (OSM) <ul style="list-style-type: none"> <li>I identify multi-use trails as publicly accessible paths designated for non-motorized use, allowing both bicycle and pedestrian access</li> <li>Filter out paths marked for hiking and mountain biking</li> <li>I identify rail trails as above <a href="#">▶ MassDOT Comparison</a></li> </ul>		✓
<b>Census:</b> 1970 - 2020 panel, harmonized to 1970 boundaries (Glaeser et al. 2025)	✓	✓

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# Greater Boston Event Study Set Up



- Rich history of rail trails
- Exploit staggered openings of trail segments
- Main results look at rail trail corridors only (pink)

**Figure:** Existing and Planned Rail Trails in Greater Boston

# Research Design

- 97 tracts with rail trail corridors
- 6 census waves (1970-2020)

Event Time =

Census Year – First Trail Opening

- Binned

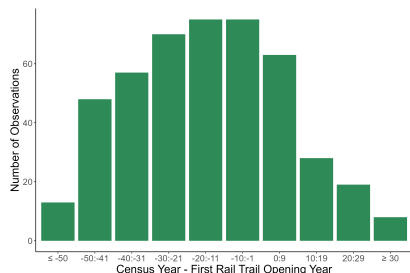


Figure: Distribution of Event Bins

# Research Design: Estimation Strategy

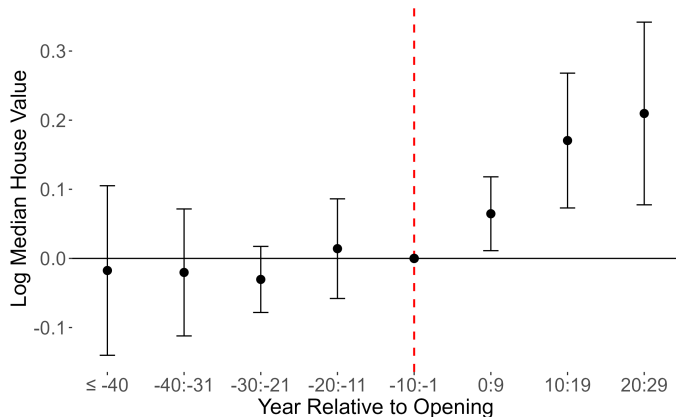
**Intuition:** Compare neighborhoods where trails opened earlier with neighborhoods where trails have not yet opened (Sun & Abraham, 2021)

$$y_{it} = \sum_g \sum_{k \neq k_0} \rho_{gk} \mathbf{1}(G_i = g) \mathbf{1}(t - G_i = k) + \alpha_i + \lambda_t + \varepsilon_{it}$$

Where

- $y_{it}$  is the outcome of interest (e.g. log median house value)
- $G_i$  is the decade in which the first trail opened
- $k$  is the decade relative to opening
- Tract and year fixed effects
- Conley SEs with 2-mile spatial cutoff
- Omitted period: decade prior to opening

# Results: Rapid and Persistent Increases in Housing Value

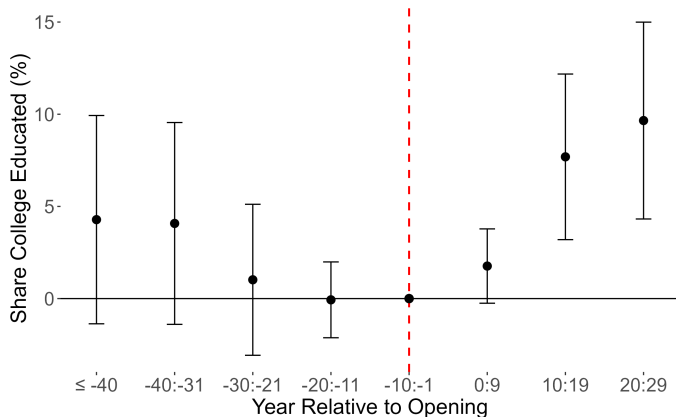


**Figure:** Rail Trail Effects on Log Median Housing Value

1970 Sample Median: \$143,374 (2020 \$)

Untreated trend: +30.6% per decade

# Results: College Educated Among First Movers

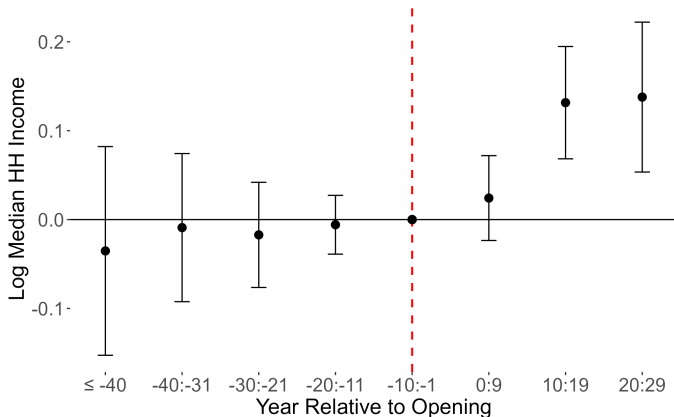


**Figure:** Rail Trail Effects on Share College Educated

1970 Sample Median: 11%

Untreated trend: 8.9 pp per decade

## Results: Increase in Area Median Income

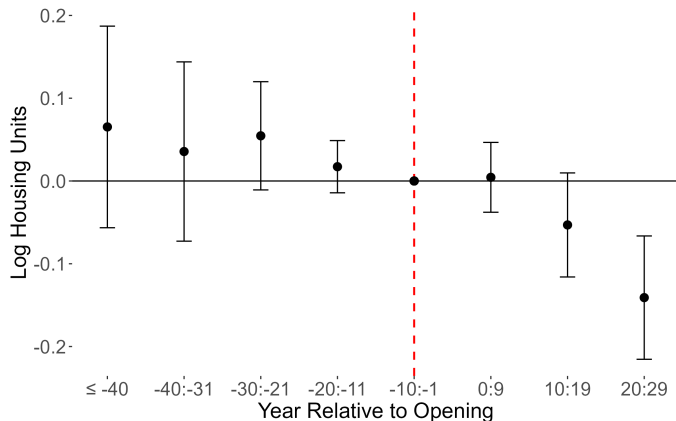


**Figure:** Rail Trail Effects on Log Median Household Income

1970 Sample Median: \$66,578 (2020 \$)

Untreated trend: 7.3% per decade

# Results: Decline in Housing Stock

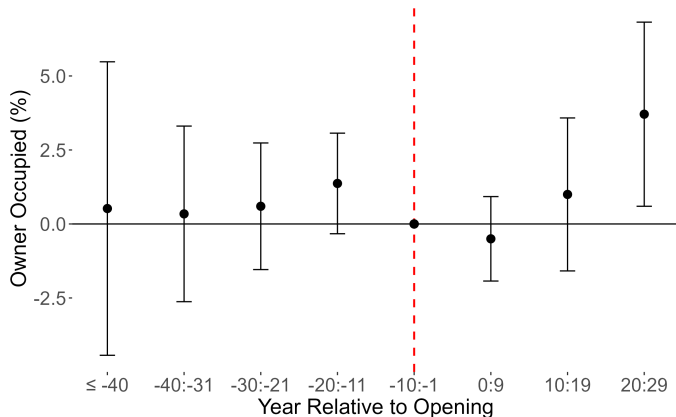


**Figure:** Rail Trail Effects on Log Number of Housing Units

1970 Sample Median: 2,039

Untreated trend: 7.5% per decade

# Results: More Housing Occupied by Homeowners

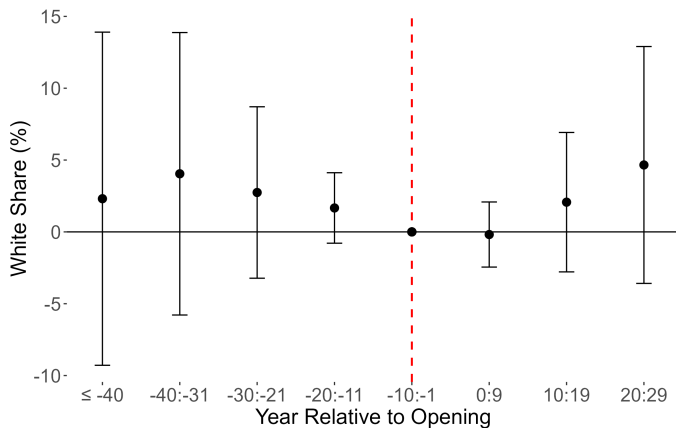


**Figure:** Rail Trail Effects on Share of Owner-Occupied Housing

1970 Sample Median: 53%

Untreated trend: -0.6 pp per decade

# Results: No Significant Evidence of White Share Change



**Figure:** Rail Trail Effects on White Share of Population

1970 Sample Median: 99%

Untreated trend: -7.1 pp per decade

# Summary: A Decade-by-Decade Pattern of Neighborhood Change

- Immediate capitalization
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- Feedback loop
  - Higher-income residents reinforce demand and oppose new development
  - By third decade, owner-occupancy +4 pp, supply falls 13%, housing prices keep rising

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# Extending the Analysis Nationally

- **Challenge:** Trail opening dates unavailable nationally; cannot replicate Boston event study

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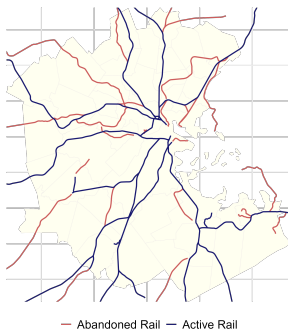
- **Challenge:** Trail opening dates unavailable nationally; cannot replicate Boston event study
- Solution in two parts
  1. **Instrumental variables:** Use predicted rail abandonment to predict where trails were more likely to be created
    - ▶ Helps separate the effect of trails from other changes happening in the same places
  2. **Long differences (1970-2020):** Compare long-run neighborhood change over 50 years
    - ▶ Captures cumulative effects
    - ▶ Accounts for stable differences across places

# Predicting Rail Abandonment: Network Based Approach

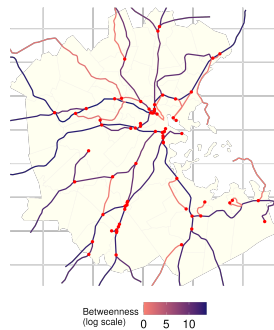
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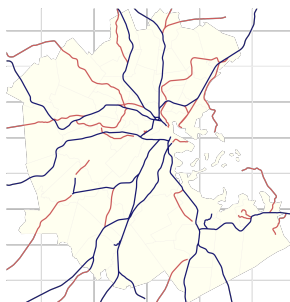
(a) Active and Abandoned Rail



(b) Rail Segment Betweenness

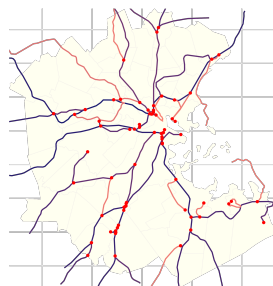
# Predicting Rail Abandonment: Network Based Approach

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— Abandoned Rail — Active Rail

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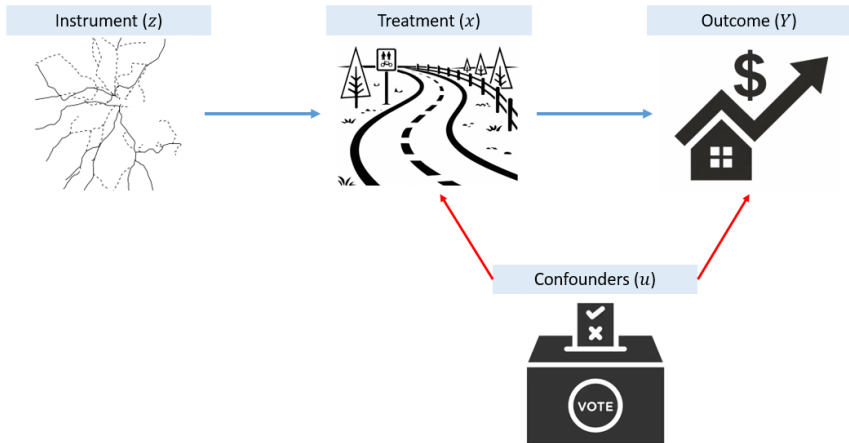


Betweenness  
(log scale) 0 5 10

(b) Rail Segment Betweenness

- “Predicted abandoned” = least connected 45% of rail mileage

# Instrument Intuition



## ▶ Instrument Validity

# Long Difference Estimation Strategy

$$\text{First Stage: } \Delta has\_trail_i = \alpha_0 + \alpha_1 \widehat{A}_i + \rho' \mathbf{X}_i + \psi_{c(i)} + \omega_i \quad (1)$$

$$\text{Second Stage: } \Delta Y_i = \pi_0 + \pi_1 \widehat{\Delta has\_trail}_i + \gamma' \mathbf{X}_i + \psi_{c(i)} + \epsilon_i \quad (2)$$

Where

- $\Delta has\_trail_i$ : indicator for whether a rail trail appears in tract  $i$  by 2020
- $\widehat{A}_i$  indicator for whether tract  $i$  contains a segment predicted abandoned rail
- $(\mathbf{X}_i)$ : Vector of controls, including indicator any rail, distance to 1970 CBD, and baseline 1970 demographic and housing characteristics
- $\Delta Y_i$ : Change in outcome (e.g., log median house value) between 1970 and 2020
- All regressions include county fixed effects; I use spatial SE with a 2-mile cutoff

# First Stage Results

**Table:** Predictions of Instrument on Actual Abandoned Rail and Trail Presence

	<i>Dependent variable:</i>	
	Has Abandoned (1)	Has Trail (2)
$\hat{A}$	0.450*** (0.009)	0.184*** (0.007)
Has Any Rail	0.287*** (0.009)	0.117*** (0.006)
F-stat	-	611
Observations	32,628	32,628
Adjusted R <sup>2</sup>	0.563	0.250

Share tracts with abandoned rail = 36%

Share with rail trail = 15%.

\* p<0.1; \*\* p<0.05; \*\*\* p<0.01.

## 2SLS Results: Housing

Table: IV Estimates of Trail Presence on Housing Changes

	<i>Dependent variable:</i>		
	$\Delta$ Log Median House Value (1)	$\Delta$ Log Housing Supply (2)	$\Delta$ Share Owner Occupied (%) (3)
$\Delta$ Has Trail (Predicted)	0.169*** (0.039)	0.212*** (0.049)	1.465 (0.978)
Interpretation:	18%	24%	1.5 pp
Mean Outcome	\$193,969	1,425	-7%
Observations	32,120	32,623	32,623
Adjusted R <sup>2</sup>	0.687	0.567	0.439

\* $p < 0.10$ , \*\* $p < 0.05$ , \*\*\* $p < 0.01$ .

## 2SLS Results: Population

Table: IV Estimates of Trail Presence on Population Changes

	<i>Dependent variable:</i>		
	$\Delta$ Share College Educated (%)	$\Delta$ Log Median HH Income	$\Delta$ Share White (%)
	(1)	(2)	(3)
$\Delta$ Has Trail (Predicted)	5.298*** (1.289)	0.134*** (0.031)	7.735*** (1.964)
Interpretation:	5.3 pp	14%	7.7 pp
Mean Outcome	29%	\$9,621	-32%
Observations	32,625	32,486	32,628
Adjusted R <sup>2</sup>	0.344	0.570	0.590

\*  $p < 0.10$ , \*\*  $p < 0.05$ , \*\*\*  $p < 0.01$ .

## IV Results Discussion

### Summary of results:

- Home values rise substantially
- Who lives nearby changes
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- Supply response differs from Boston
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### Key takeaways:

- Results comparable to high-profile projects (NY High Line: +35%, Atlanta BeltLine: +18%)
- Ordinary rail trails produce significant impacts
- Massive increases in housing value likely due to co-location of other amenities following sorting rather than rail trail itself

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Thank you!  
xli@g.harvard.edu



# Why are Multi-Use Trails Built on Abandoned Railways?

- Gentle gradients
- Multiple points of access
- Separation from vehicular traffic & tree-lined

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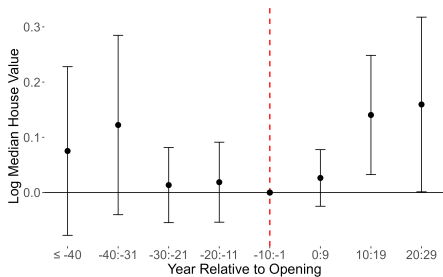
- Gentle gradients
- Multiple points of access
- Separation from vehicular traffic & tree-lined
- Potential to acquire long linear corridor in one purchase
- Legal framework to support rail-to-trail conversions
  - National Trails System Act Amendments of 1983

◀ Back

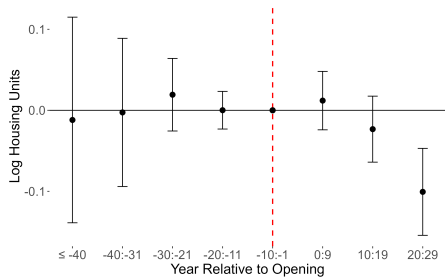




# Event Study All Tracts



(a) House Value

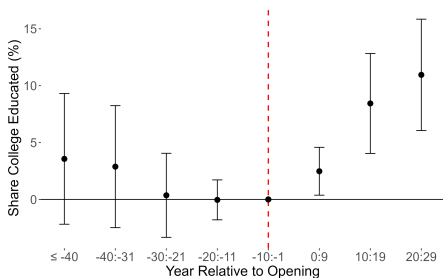


(b) Housing Supply

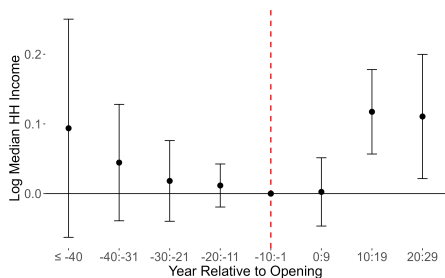
Figure: Event Study All Tracts

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# Event Study All Tracts



(a) College Share

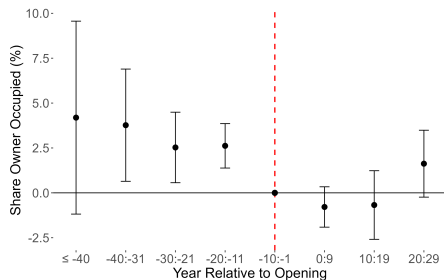


(b) Household Income

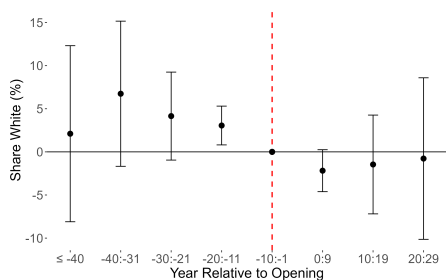
Figure: Event Study All Tracts

← Back

## Event Study All Tracts



(a) Share Owner Occupied



(b) Share White

Figure: Event Study All Tracts

[← Back](#)

# Instrument Validity

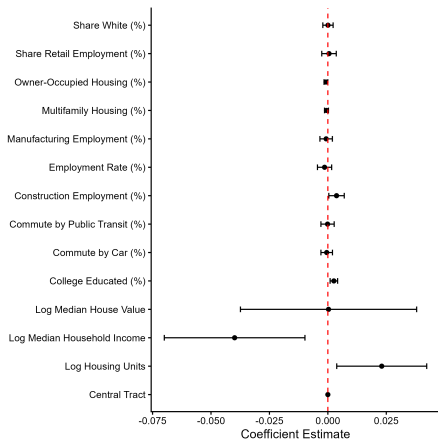
- **Relevance:** Predicted abandoned rail predicts trail development
- **Independence:** Predicted abandoned rail as good as randomly assigned
  - Prediction derived entirely from network geometry, should avoid legacy factors (e.g. industrial decline) that drove actual abandonment
    - ▶ Rail Facts
    - ▶ Balance
- **Exclusion Restriction:** Predicted abandoned rail affects outcome only through trail development
  - Violation would occur (most obviously) if abandoned rail directly affects outcomes
    - ▶ Stakeholder interviews suggest this is not the case
    - ▶ Little evidence from the full sample Boston event study [▶ Full Sample](#)
- **Monotonicity:** Predicted abandoned rail affects the likelihood of trail development in the same direction (i.e. would not reduce likelihood of trail development)
  - Institutional details

# Balance in 1970 Baseline Characteristics

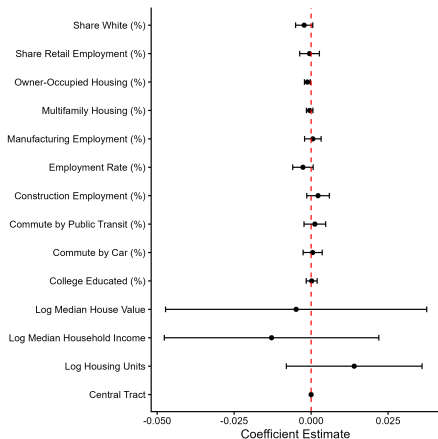
**Table:** Wald Test, Sample: Tracts with Any Rail

	Has Rail Trail	Has Predicted Rail
F-Statistic	3.155	1.314
p-value	0.0000	0.16
Observations	20,438	20,438

## Balance on 1970 Baseline Characteristics



(a) Rail Trail



(b) Predicted Rail