

# Public Transport: a Route to Reduce Employment Gap?

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## Female Labor Force Participation:

- In the 20th century, the US experienced substantial growth in women's labor force participation rates, escalating from 20% to 75% (Goldin, 2006)
- Gender convergence has recently slowed down
- The US still has a 10% gender gap, and hourly wages are 18% smaller for women compared to men (Petrongolo and Ronchi, 2020)

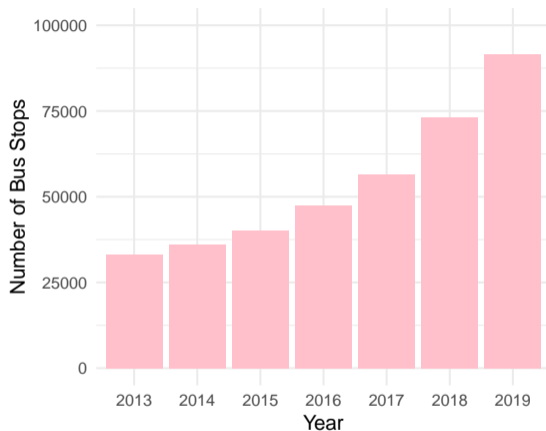
## Women and Commuting:

- Women have heavier caring responsibilities in the household
- Women commute shorter distances than men because women with children prefer to work closer to home (Rosenthal and Strange, 2012; Borghorst et al. 2021)

## American Policy:

- In 2021 President Biden announced the Infrastructure Investment and Jobs Act which includes \$89.9 billion in guaranteed funding for public transit over five years
- 24,000 buses, 5,000 rail cars, and 200 stations
- The largest Federal investment in public transit in US history

# The Road to Changes



- Mean Dist. from a Bus Stop: 7 kilometers
- Mean Dist. Reduction – Overall  $\Delta = 700$  meters; Among Treated  $\Delta = 3.5$  kilometers

## Goals:

- Show gender differences in commuting sensitivity
- Check that public transport is more important for female labor decisions
- Highlight variation by socio-economic groups
- Decompose Job Access: **Access to new more distant locations** and **New jobs in already accessible locations**
- Estimate effect of new bus stops on employment gap

## Contribution:

- Use of census tract-level (granular) data
- Focus on local labor markets
- Taking into account Job Access endogeneity via IV and geospatial matching

## **Labor market participation:**

- Participation in the labor market (Gronau, 1977)
- Female participation (Killingsworth and Heckman, 1986)
- Gender differences in sensitivity to commuting time (van den Berg and Gorter 1997; Black et al. 2014; Mulalic et al. 2014; Le Barbanchon et al. 2019)
- Gender gap (Petrongolo and Ronchi, 2020)
- Equilibrium unemployment rate: non-spatial and spatial (Wasmer and Zenou, 2000)

## **Infrastructure:**

- Treatment effects of infrastructure projects (Kline and Moretti, 2014b)
- High-speed rail construction and regional employment (Lin, 2017)
- Nonrandom exposure to exogenous transport shocks (Borusyak and Hull, 2023)

## Chetty's Opportunity Atlas:

- All children in the 1978-83 birth cohorts who were born in the U.S. and whose parents were also U.S. citizens
- Average male/female employment (by tract) in 2015 and individual income (by tract) in 2014-2015
- For individuals who live in 2015 at the same area as in their childhood
- Neighborhood socioeconomic characteristics in previous periods by census tracts

## **Origin-Destination Employment Statistics (LODES):**

- Residence Area Characteristic data, all private jobs are totaled by home Census Block
- Workers age 30 to 54
- Number of jobs for male and female workers in 2013-2019

## Access Across America: Transit

- Annual accessibility to jobs by transit in 46 of the 50 largest (by population) metropolitan areas in the United States for 2014-2019
- Number of jobs reachable from each census block within 30 minutes by public transport or walk

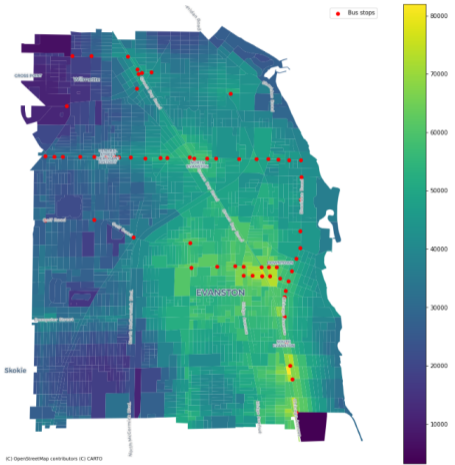
## OpenStreetMap:

- Bus stop locations by days from 2014 to 2016

## Merged data set:

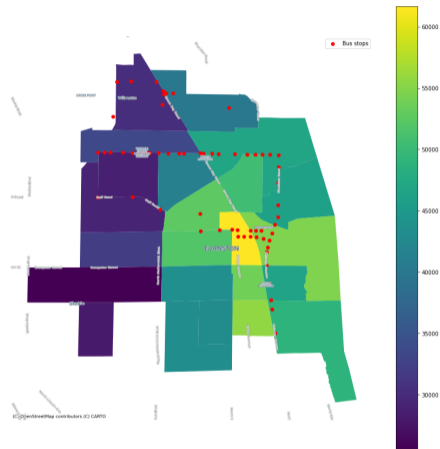
- 25,575 census tracts from 34 states

# Number of Jobs Accessible Within 30 min. by Transit (Block)



Nb. jobs reachable from a census block within 30 minutes in 2014 by public transport or walk

# Number of Jobs Accessible Within 30 min. by Transit (Tract)



***Short-Commute Jobs Access 2014*** – average number of jobs reachable from a census tract within 30 minutes in 2014 by public transport or walk

$$Y_{ic} = \alpha \cdot Treatment_i + X_i' \beta + \omega_c + \varepsilon_{ic}$$

- **Where**  $Y_{ic}$  is one of:
  - Female employment rate in 2015
  - Male employment rate in 2015
  - Employment gap (Male - Female, in p.p.) in 2015
- **Key variables:**
  - $Treatment_i$ :
    - $\Delta\%$  Short-Commute Job Access (14-15) =  $\Delta$  Bus Stops (14-15) +  $\Delta\%$  Local Jobs (14-15)
  - $X_i$ : Controls for tract-level socio-economic characteristics
  - $\omega_c$ : County fixed effects
- **Hypotheses:**
  - H1:  $\alpha_{female} > \alpha_{male} > 0$ , only  $\alpha_{female}$  significant
  - H2:  $\alpha_{gap} < 0$ , significant
- **Spatial Lag:** Weighted average of outcomes in nearby census tracts (within 20 km), with closer tracts receiving more weight – proxy for a network

# Descriptive Statistics

Variable	Min	1st Quartile	Median	Mean	3rd Quartile	Max
$\Delta\%$ Short-Commute Jobs Access 2014–15	-57.23	-13.65	-4.01	1.39	7.25	177.47
New Bus Stops 2014–15	-31.00	0.00	0.00	0.19	0.00	64.00
$\Delta\%$ Total Local Jobs 2014–15	-45.07	-3.89	2.88	4.29	10.51	83.61
Male Employment Rate 2015 (%)	36.57	73.73	78.69	77.89	82.78	99.97
Female Employment Rate 2015 (%)	29.62	72.46	75.79	75.64	79.54	97.08
Employment Gap 2015 (p.p.)	-42.85	-2.02	2.79	2.10	6.90	50.15
Total Population	893	3,158	4,286	4,479	5,604	10,430
Area (sq. mi.)	0.061	0.496	0.981	3.72	2.13	162.11

More than 25,000 census tracts (35% of all census tracts) in 46 of the 50 largest (by population) metropolitan areas in the United States

# Δ% Short-Commute Jobs Access 2014–15 Decomposition

	<i>Dependent variable: Δ% Short-Commute Jobs Access 2014–15</i>							
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
<b>New Bus Stops 2014–15</b>	0.612*** (0.160)				0.346* (0.193)	0.405*** (0.143)	0.422*** (0.146)	0.422** (0.173)
Spatial Lag New Bus Stops 2014–15		1.308*** (0.234)			1.042*** (0.294)	1.244 (0.931)	1.792* (0.926)	1.792 (3.511)
Δ% Total Local Jobs 2014–15			0.004 (0.013)		–0.005 (0.013)	0.001 (0.012)	0.011 (0.011)	0.011 (0.011)
<b>Spatial Lag Δ% Total Local Jobs 2014–15</b>				0.758*** (0.091)	0.777*** (0.092)	1.062*** (0.144)	0.827*** (0.140)	0.827*** (0.294)
County FE	No	No	No	No	No	Yes	Yes	Yes
Census Tract Controls	No	No	No	No	No	No	Yes	Yes
Standard Errors	HC4	HC4	HC4	HC4	HC4	HC4	HC4	CSE
Observations	25,575	25,575	25,575	25,575	25,575	25,575	25,575	25,575
$R^2$	0.001	0.001	0.000	0.005	0.006	0.235	0.248	0.248
Adjusted $R^2$	0.001	0.001	0.000	0.005	0.006	0.225	0.237	0.237

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

# Effect of New Bus Stops on Employment Gap in 2015 (OLS)

	Dependent variable: Employment Gap in 2015								
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Δ% Short-Commute Jobs Access 2014–15	-0.003** (0.001)								
New Bus Stops 2014–15		-0.073*** (0.027)				-0.069** (0.034)	0.014 (0.027)	0.032 (0.021)	0.032 (0.026)
<b>Spatial Lag New Bus Stops 2014–15</b>			-0.088* (0.051)			0.016 (0.065)	<b>-1.570***</b> (0.148)	<b>-1.206***</b> (0.133)	<b>-1.206***</b> (0.307)
Δ% Total Local Jobs 2014–15				0.009*** (0.003)		0.007*** (0.003)	0.007*** (0.002)	0.005** (0.002)	0.005** (0.002)
Spatial Lag Δ% Total Local Jobs 2014–15					0.203*** (0.016)	0.200*** (0.016)	0.268*** (0.024)	0.146*** (0.021)	0.146*** (0.045)
County FE	No	No	No	No	No	No	Yes	Yes	Yes
Census Tract Controls	No	No	No	No	No	No	No	Yes	Yes
Standard Errors	HC4	HC4	HC4	HC4	HC4	HC4	HC4	HC4	CSE
Observations	25,316	25,316	25,316	25,316	25,316	25,316	25,316	25,316	25,316
R <sup>2</sup>	0.0002	0.0003	0.0001	0.001	0.007	0.008	0.223	0.439	0.439
Adjusted R <sup>2</sup>	0.0002	0.0003	0.0001	0.0005	0.007	0.007	0.213	0.431	0.431

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

# Effect of New Bus Stops on Female Employment in 2015 (OLS)

	<i>Dependent variable: Female Employment in 2015</i>								
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
$\Delta\%$ Short-Commute Jobs Access 2014–15	-0.004*** (0.001)								
New Bus Stops 2014–15		0.051*** (0.016)				-0.048** (0.019)	-0.038* (0.020)	-0.032* (0.019)	-0.032* (0.017)
<b>Spatial Lag New Bus Stops 2014–15</b>			0.298*** (0.031)			<b>0.313***</b> (0.037)	<b>0.185*</b> (0.101)	<b>0.329***</b> (0.098)	0.329 (0.216)
$\Delta\%$ Total Local Jobs 2014–15				-0.007*** (0.002)		-0.003 (0.002)	0.001 (0.002)	0.001 (0.002)	0.001 (0.002)
Spatial Lag $\Delta\%$ Total Local Jobs 2014–15					-0.267*** (0.013)	-0.262*** (0.013)	-0.015 (0.017)	-0.019 (0.016)	-0.019 (0.039)
County FE	No	No	No	No	No	No	Yes	Yes	Yes
Census Tract Controls	No	No	No	No	No	No	No	Yes	Yes
Standard Errors	HC4	HC4	HC4	HC4	HC4	HC4	HC4	HC4	CSE
Observations	25,340	25,340	25,340	25,340	25,340	25,340	25,340	25,340	25,340
$R^2$	0.001	0.0003	0.002	0.0004	0.023	0.023	0.375	0.375	0.375
Adjusted $R^2$	0.001	0.0002	0.002	0.0004	0.023	0.023	0.367	0.367	0.367

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

# Effect of New Bus Stops on Female Employment in 2015 (Poor Parents)

	Dependent variable: Female Employment in 2015 (Poor Parents – p25)								
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Δ% Short-Commute Jobs Access 2014–15	–0.003** (0.001)								
New Bus Stops 2014–15		0.069*** (0.025)				–0.008 (0.028)	–0.029 (0.026)	–0.031 (0.024)	–0.031 (0.025)
<b>Spatial Lag New Bus Stops 2014–15</b>			0.261*** (0.047)			<b>0.241*** (0.059)</b>	<b>0.674** (0.150)</b>	<b>0.569*** (0.145)</b>	<b>0.569*** (0.133)</b>
Δ% Total Local Jobs 2014–15				–0.007** (0.003)		–0.004 (0.003)	–0.002 (0.002)	–0.002 (0.002)	–0.002 (0.002)
Spatial Lag Δ% Total Local Jobs 2014–15					–0.198*** (0.017)	–0.193*** (0.017)	–0.068** (0.026)	–0.022 (0.026)	–0.022 (0.039)
County FE	No	No	No	No	No	No	Yes	Yes	Yes
Census Tract Controls	No	No	No	No	No	No	No	Yes	Yes
Standard Errors	HC4	HC4	HC4	HC4	HC4	HC4	HC4	HC4	CSE
Observations	25,295	25,295	25,295	25,295	25,295	25,295	25,295	25,295	25,295
R <sup>2</sup>	0.0002	0.0003	0.001	0.0003	0.006	0.007	0.150	0.204	0.204
Adjusted R <sup>2</sup>	0.0002	0.0002	0.001	0.0002	0.006	0.007	0.139	0.193	0.193

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

# Job Access in Employment Gap in 2015 (OLS & IV)

	<i>Dependent variable: Employment Gap in 2015</i>						
	OLS				IV – by New Bus Stops 2014-15		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
$\Delta\%$ Short-Commute Jobs Access 2014–15	-0.003** (0.001)		-0.002 (0.002)	-0.003** (0.001)	-0.239*** (0.063)		0.066 (0.111)
<b>Spatial Lag <math>\Delta\%</math> Short-Commute Jobs Access 2014–15</b>		-0.005* (0.003)	-0.002 (0.003)	0.027*** (0.004)		<b>-0.991*** (0.197)</b>	<b>-1.120*** (0.298)</b>
County FE	No	No	No	Yes	Yes	Yes	Yes
Census Tract Controls	No	No	No	Yes	Yes	Yes	Yes
F Statistic (IV)					21.18	15.81	14.7
Observations	25,316	25,316	25,316	25,316	25,316	25,316	25,316

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

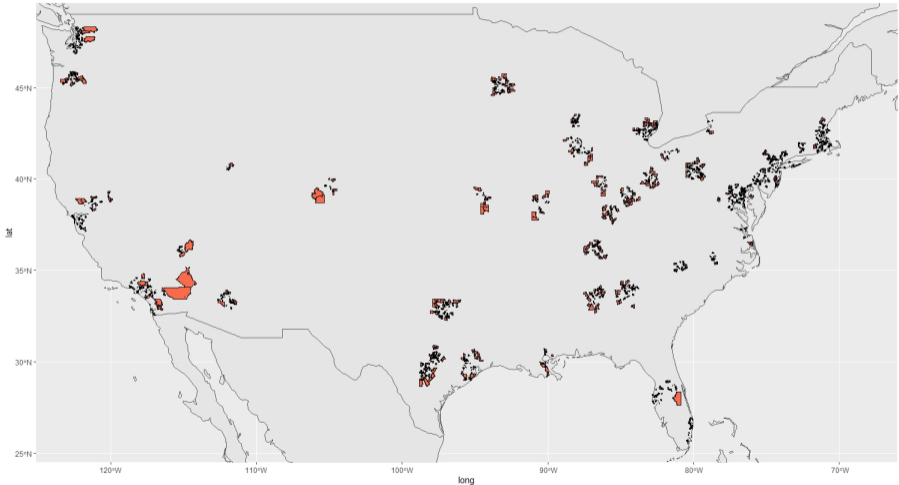
## Problem:

- Bus stop location can be driven by population density, the existing bus network, share of low-income residents, share of students, etc.
- Better to compare census tracts with a similar chance of being selected in the same local labour market

## Geospatial Matching:

- Select census tracts with new bus stops (treatment group)
- Candidates for matching: census tracts without new bus stops sharing a border with a treated
- Match neighbouring census tracts with similar observables – same percentiles by population density, poverty, etc.
- Should be no statistical difference by matching parameters

# All Chosen Tracts in the United States

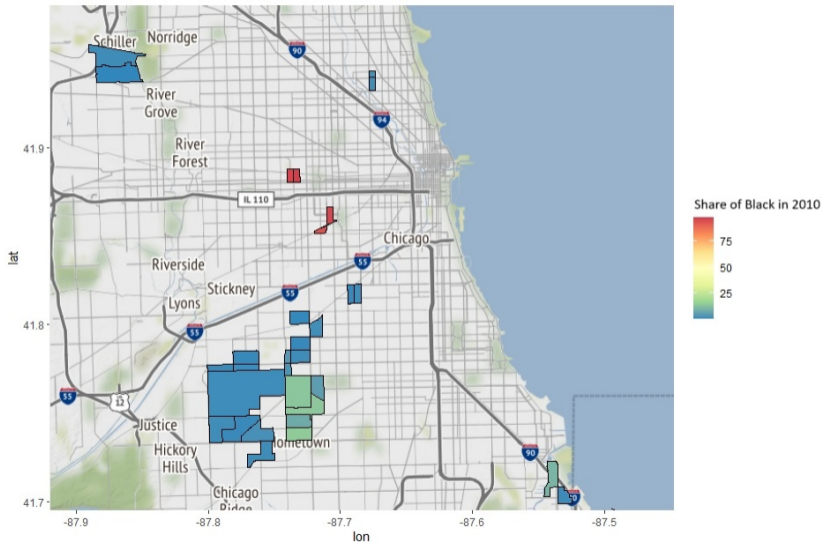


# Balance Tests after Geographic Matching

Variable	Control	Treatment	p-value
Short-Commute Jobs Access in 2014	10256	9664	0.750
Average Job Growth Rate 2004-2013	0.019	0.037	0.000
Criminal Level	0.011	0.011	0.623
Share of Black in 2010	0.09	0.09	0.996
Share of Hispanics in 2010	0.171	0.180	0.445
Share of Asians in 2010	0.048	0.052	0.311
Share of Poor in 2010	0.101	0.101	0.896
Share of Educated in 2010	0.309	0.305	0.655
Share of Foreigners in 2010	0.134	0.143	0.197
Job Density in 2013	1137	1143	0.951
Population Density in 2010	4420	4452	0.920
Rent Prices Level in 2015	1108	1118	0.617
Share of Single Parents in 2010	0.279	0.283	0.641



# Matched Pairs Have Similar Shares of Black



# ↑ Public Transport Infrastructure ⇒ Employment Gap ↓

	<i>Dependent variable:</i>			
	Employment Gap in 2015		Female Employment in 2015	Male Employment in 2015
	(1)	(2)	(3)	(4)
<b>Δ Short-Commute Jobs Access 2014-2015</b>	-0.003 (0.002)	-0.004** (0.002)	0.005*** (0.002)	0.0001 (0.002)
Short-Commute Jobs Access in 2014	0.000 (0.001)	0.000 (0.001)	-0.001*** (0.000)	-0.001 (0.001)
Average Job Growth Rate 2004-2013	4.479*** (1.488)	2.712* (1.580)	-1.612 (1.454)	1.100 (1.302)
Dependent Variable Mean	4.21	4.21	75.24	79.45
Socioeconomic Controls	Yes	Yes	Yes	Yes
County Fixed Effect	No	Yes	Yes	Yes
Observations	1,721	1,721	1,721	1,721
R <sup>2</sup>	0.283	0.467	0.495	0.613
Adjusted R <sup>2</sup>	0.277	0.376	0.409	0.547

Note: Individual level data. \*p<0.1; \*\*p<0.05; \*\*\*p<0.01; county-level clustered standard errors (CSE)

- **Employment Gap in 2015:** 1st Qu. 0.41, Median 4.55, Mean 4.21, 3rd Qu. 8.38
- **Δ Sh.-Comm. Jobs Access:** 1st Qu. -2.23, Median 14.57, Mean 29.01, 3rd Qu. 35.05

## What is used:

- Census tract-level data on labor market participation, job access, new bus stops, and job creation in 2014 and 2015
- Individuals who live in the same tract as during their childhood

## Preliminary results:

- $\Delta\%$  Short-Commute Job Access (2014–15) is driven by new bus stops in the census tract and new jobs in the neighbourhood
- The employment gap in 2015 is reduced by the spatial lag of new bus stops (2014–15)
- The effect on female labor force participation is stronger for women from poor families

## Next step:

- Changes in the distance to bus stops at the census-block level (higher granularity)
- Panel with millions of observations from 2013 to 2019