Bike-Sharing Systems and the Transportation Modal Choice Problem: A Natural Experiment in New York City

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Introduction:

- The Citi Bike program was introduced on May 27, 2013 in Lower Manhattan and Brooklyn
- The Transportation Modal Choice Problem was first investigated by Daniel McFadden during the implementation of the BART in San Francisco
- I build on his research with an econometric analysis of the relationship between bike-sharing and subway ridership

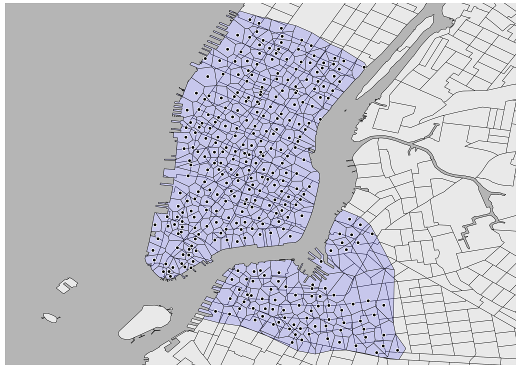

Fig 1. Citi Bike Station Distribution at Launch

Dataset	Source	Date Range
Citi Bike Ridership	Citi Bike	May 2013 to December 2014
Subway Ridership	MTA	January 2011 to December 2014
Weather	NOAA	January 2011 to December 2014
Land Use	NYC Planning	N/A

Methodology:

- For Citi Bike program effect, the experimental effect of interest is given by the difference-in-differences estimator:

$$(\mathbb{E}[ridership_{jat} \mid a=1, t=1] - \mathbb{E}[ridership_{jat} \mid a=1, t=0]) -$$
$$(\mathbb{E}[ridership_{jat} \mid a=0, t=1] - \mathbb{E}[ridership_{jat} \mid a=0, t=0]) = \beta$$

- I estimate this coefficient by exploiting the time variation in ridership using the "within" panel regressions:

$$ln(Entries_{jt}) = \alpha + \psi ln(Exits_{jt}) + \beta BikeOpen_t \times BikeStations_{jt} + \gamma StationFE_j$$
$$+ \delta DowFE_t + \phi Month_t + \lambda Controls'_t + \varepsilon_{jt}$$

- Next, I estimate the effect of subway ridership on the Citi Bike program by exploiting cross-sectional variation across stations using the "between" panel regressions:

$$OriginsAM_j = \alpha + \beta DestinationsAM_j + \eta Stations_j + \omega Racks_j$$
$$+ \sigma Lanes_j + \psi log(Population_j) + \phi CommercialShare_j$$
$$+ \nu ManufacturingShare_j + \gamma ResidentialShare_j + \varepsilon_j$$

Results:

Table 2: Within Estimation with Bike Stations as Infrastructure Measure

	Dependent variable:			
	log(Entries)	log(Exits)	log(Entries)	log(Exits)
	Manhattan Only		Manhattan and Brooklyn	
	(1)	(2)	(3)	(4)
Bike Stations within 200m	−0.001	0.019**	−0.002	0.022***
	(0.009)	(0.008)	(0.008)	(0.007)
Observations	85,162	85,162	104,835	104,835
R^2	0.477	0.512	0.525	0.551
Adjusted R^2	0.476	0.511	0.524	0.550
Note:	*p<0.1; **p<0.05; ***p<0.01			

Table 7: The First Mile: Cross-Sectional Variation Effects on Citi Bike Ridership

	Dependent variable:	
	AM Origins	AM Destinations
	(1)	(2)
AM Destinations	0.776***	
	(0.049)	
AM Origins		0.564***
		(0.036)
Subway Stations within 200m	−0.675**	0.577**
	(0.341)	(0.291)
Commercial Land Use Share	0.095	−0.113**
	(0.064)	(0.055)
Residential Land Use Share	1.807***	−4.069***
	(0.682)	(0.543)
Observations	332	332
R^2	0.502	0.620
Adjusted R^2	0.489	0.611
Note:	*p<0.1; **p<0.05; ***p<0.01	

Implications:

- The complementary effect between modes is stronger than the substitution effect
- Bike riders flow from residential areas to subways in the morning and from subways to residential areas in the evening
- Ridership behavior suggests that bike-sharing is a feasible solution to the first mile, last mile problem

References:

- Campbell, Kayleigh B., and Candace Brakewood. "Sharing riders: How bikesharing impacts bus ridership in New York City." Transportation Research Part A: Policy and Practice 100 (2017): 264-282.
- Noland, Robert B., Michael J. Smart, and Ziye Guo. "Bikeshare trip generation in New York city." Transportation Research Part A: Policy and Practice 94 (2016): 164-181.