

# Getting to Work

## A Spatial Equity Analysis of Public Transportation Accessibility and Commute Burdens in Eastern Massachusetts

### BACKGROUND

Traffic congestion in the Greater Boston region costs the average driver \$2,291 per year in direct fuel costs and cost of lost work and leisure time<sup>1</sup>. Inadequate transportation networks are a burden on commuters who lack resources to afford to live near more expensive, job-rich neighborhoods<sup>2</sup>. This project will investigate the spatial and demographic determinants of difficult commutes for residents of the Boston Metropolitan region, defined as core-based statistical areas east of Worcester. For the purposes of this project, a 45 minute commute is deemed reasonable and a commute of 60 minutes or longer is deemed a burden.

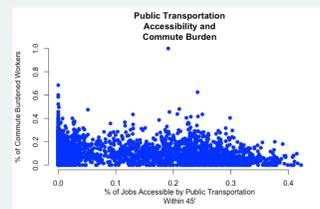
### RESEARCH QUESTIONS

**Question 1:** Are vulnerable populations in Eastern Massachusetts more likely to live in areas with lower public transportation access to the job market?

**Question 2:** To what extent does public transportation access to the job market predict percentage of commute burdened workers?

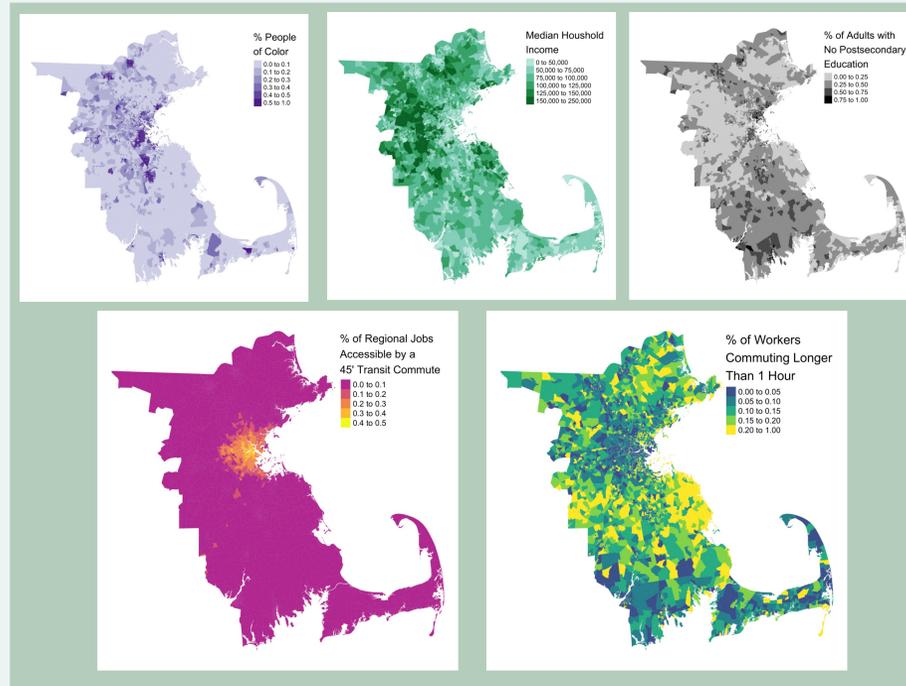
### METHODS

In order to answer Question 1, I used data on transportation options available to commuters. The Environmental Protection Agency provides data on the percentage of the regional job market that is reachable by a 45 minute commute via public transportation. This variable, delineated by census block group (CBG), is a good indicator of how likely a worker is to both find a job that is accessible by public transportation and choose that as their primary mode of commuting. Model 1 shows the relationship between race, education, and median income of a CBG and the percentage of regional employment accessible by a 45 minute public transportation commute.



Question 2 requires information on how long people spend traveling to work. I used data on the percentage of workers in a CBG that report traveling over 60 minutes to their job. Model 2 shows the extent to which accessibility to the job market via public transportation can predict the percentage of residents of a CBG that spend longer than 60 minutes commuting by any mode.

I first conducted an exploratory spatial data analysis by mapping all variables of interest and exploring relevant scatterplots. I then conducted ordinary least squares (OLS) regressions and spatially



lagged regressions to answer both of the research questions. The spatially lagged regressions use a Queen's 3rd order contiguity weights matrix to account for the underlying spatial clustering of land use and transportation patterns. Each regression additionally controls for residential density, employment density, and percentage of the population of working age (25-64).

### RESULTS & DISCUSSION

#### Model 1: Access to Jobs via Public Transportation $R^2 = 0.50$ $R^2 = 0.94$

Variable	OLS	Spatial Lag
% people of color	0.175***	0.010***
% no postsecondary education	-0.175***	-0.010**
Median Household Income	-2.382 x 10 <sup>-7</sup> ***	-1.088 x 10 <sup>-7</sup> ***

\*p<0.05, \*\*p<0.01, \*\*\*p<0.001.

Model 1 shows that CBGs with higher percentages of people of color and lower median incomes tend to have better access to the regional job market by public transportation. It also shows a disadvantageous effect for CBGs with higher percentages of people with no post-secondary education. Notably, the spatial lag accounts for 44% of the variation in access to the job market via public transportation. This is in line with expectations based on the clustered nature of the transit network and resulting land use patterns.

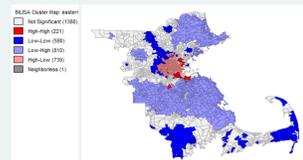
#### Model 2: Commute Burden $R^2 = 0.06$ $R^2 = 0.24$

Variable	OLS	Spatial Lag
% people of color	0.047***	0.032***
% no postsecondary education	-0.020*	-0.019*
Median Household Income	1.011 x 10 <sup>-7</sup> *	8.166 x 10 <sup>-8</sup>
% of jobs accessible within 45' using public transportation	-0.163***	-0.059***

\*p<0.05, \*\*p<0.01, \*\*\*p<0.001.

Model 2 demonstrates a lower  $R^2$  value but still significant patterns, mirroring Model 1, relating to race, education, and income. Better access to the job market via public transportation is the strongest predictor of lower percentages of commute burdened workers.

Light blue areas of a Bivariate Local Moran's I cluster map indicate clustering of low access to the job market via public transportation and high commute burdens. These three clusters of 1) South Shore extending westward through Brockton and Franklin, 2) area surrounding Acton, and 3) North Shore from Gloucester to Haverhill are prime areas for further study into public transportation networks as a possible means of alleviating commute burdens.



### CONCLUSION & FURTHER RESEARCH

Based on this research, people with no post-secondary education are more likely than their more educated peers to have lower access to the job market via public transportation and are more likely to be commute burdened, traveling over 60 minutes to work each day. Further research should differentiate between urban and suburban landscapes to isolate the effects of education, income, and race between different built and socio-economic environments.

### REFERENCES & DATA SOURCES

- <sup>1</sup>Inrix 2018 Global Traffic Scorecard. <http://inrix.com/press-releases/scorecard-2018-us/>
- <sup>2</sup>Ong, Paul and Evelyn Blumenberg. "Job Access, Commute, and Travel Burden Among Welfare Recipients." *Urban Studies*35, no. 1 (January 1998): 77-93.
- Data: U.S. Environmental Protection Agency, Smart Location Database, 2010.  
U.S. Census Bureau, American Community Survey, 5-Year Estimates, 2013.

Tess Ruderman  
Spatial Statistics, Spring 2019  
Urban & Environmental  
Policy & Planning

**Tufts**  
UNIVERSITY  
Graduate School  
of Arts and Sciences