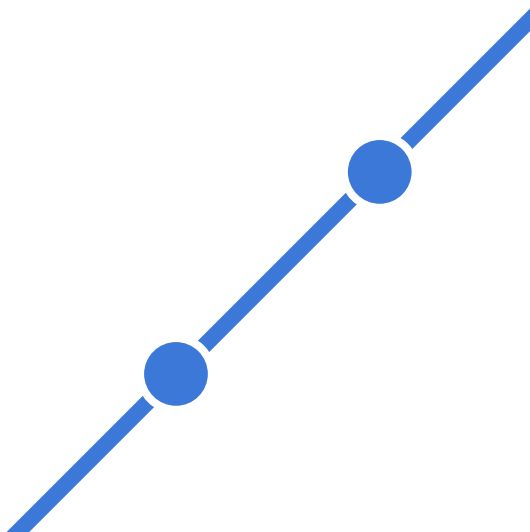
Transit Access to Employment across Canada: Taking Stock of Income Inequalities

Jeff Allen & Steven Farber,

SAUSy Lab,

Department of Geography & Planning,

University of Toronto



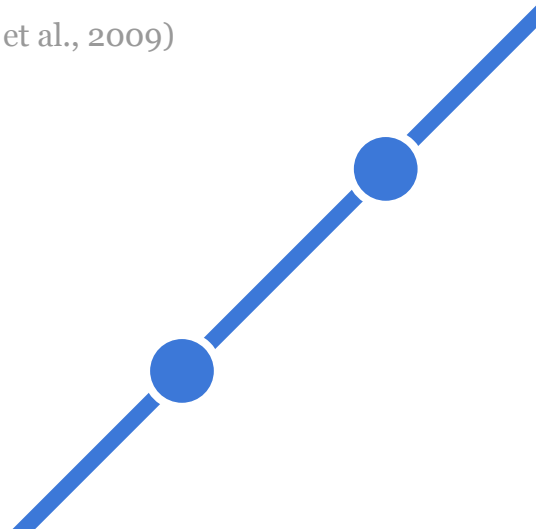
Background:

+ Across Canada, millions of urban residents rely on transit to commute to work

+ However, many neighbourhoods do not have sufficient transit access

+ Low accessibility, compounded with other forms of social disadvantage, can result in transport poverty (e.g. Lucas, 2012)

+ This can result in limited activity participation (e.g. Paez et al., 2009)



Background:

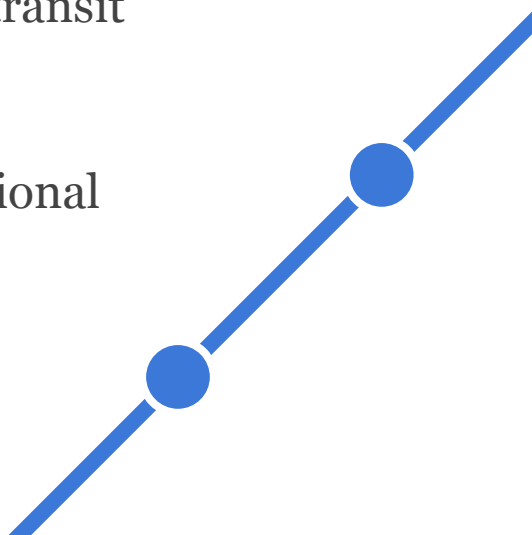
+ Increasing income inequality in Canadian cities (e.g. Walks & Twigge-Molecey, 2014)

+ Higher costs of living in city centres, and increasing concentration of poverty in suburban areas (e.g. Ades et al., 2012)

+ Suburban areas tend to have relatively worse transit service

+ Governments across Canada are investing billions in transit (e.g. Canadian Federal Budget, 2017)

+ The extent of transport poverty is unknown at the national scale.

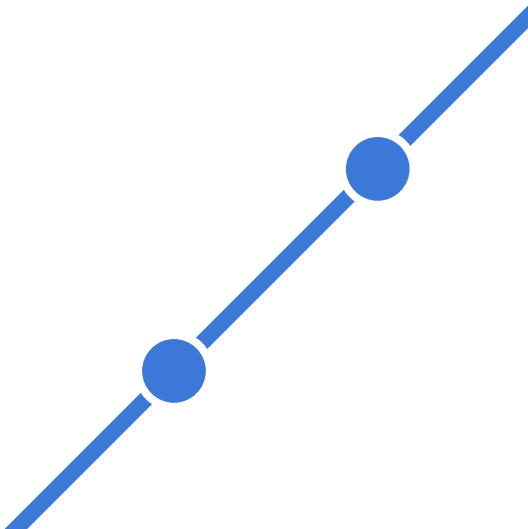


Objectives:

1 - Compute accurate measures of access to employment for Canadian cities.

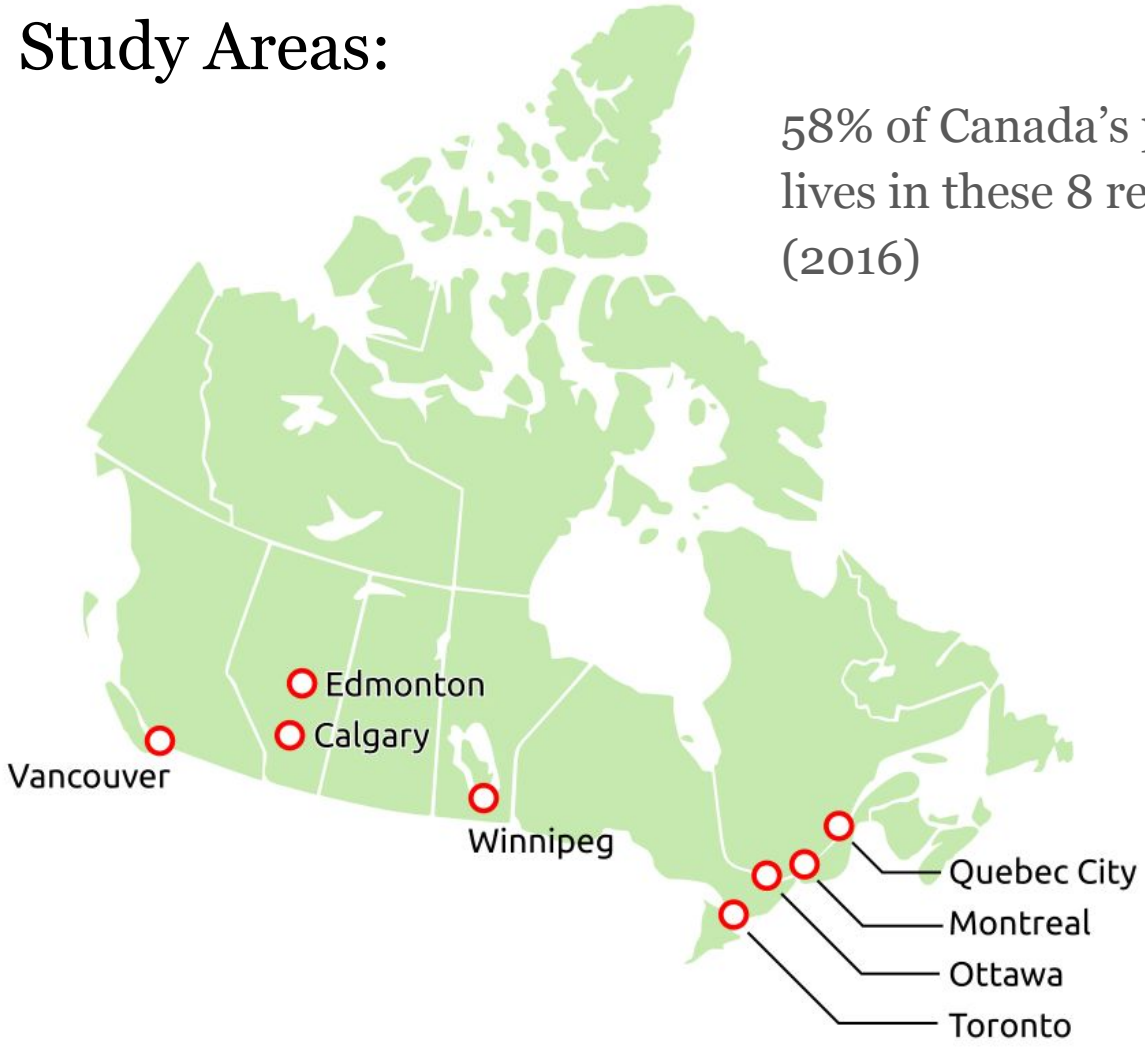
2 - Analyze the inequality of transit access to jobs, with respect to socio-economic status.

3 - Estimate the number of people at risk of transport poverty.



Study Areas:

58% of Canada's population lives in these 8 regions (2016)



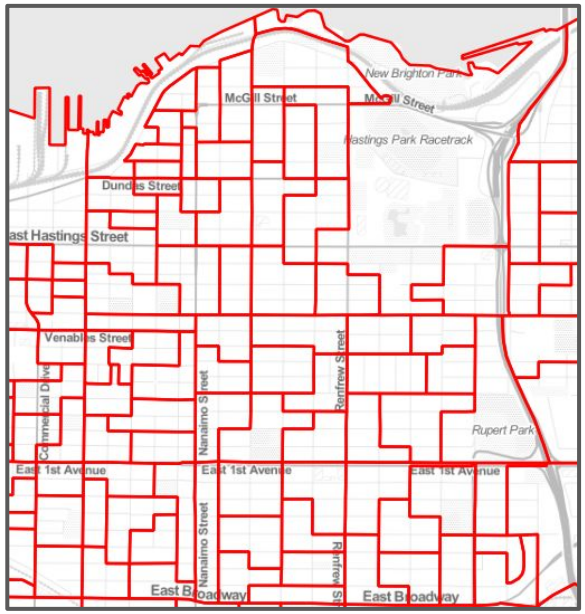
Data Sources:

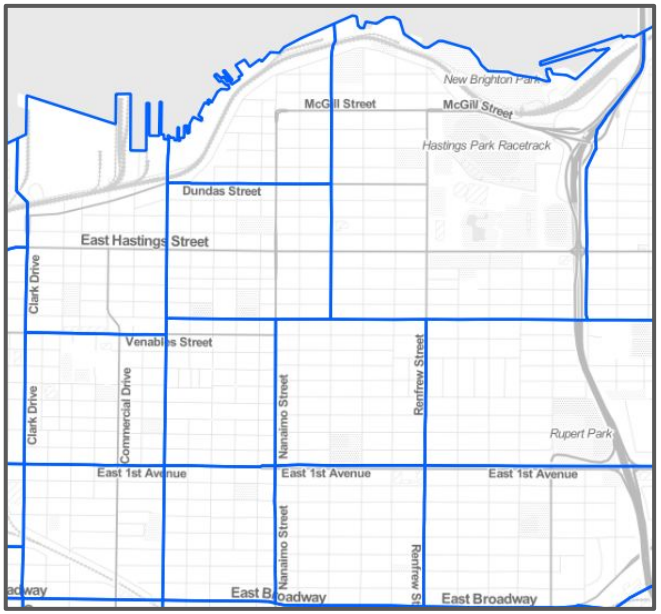
2016 Canadian Census

Census Metropolitan Areas (CMAs) - boundaries of analysis

Dissemination Areas (DA) - household demographic and socio-economic data

Census Tracts (CT) - employment data





Data Sources:

Multi-modal network graphs

> Built with OpenTripPlanner & OSRM

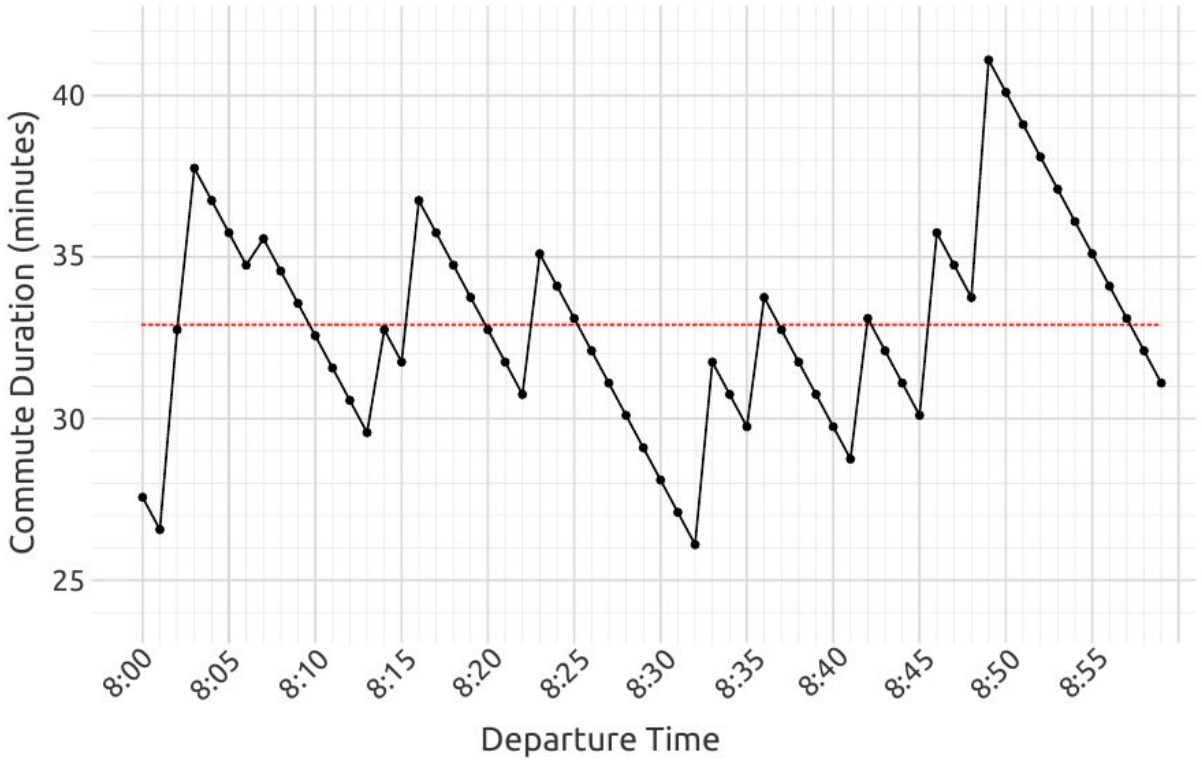
> Inputs: OpenStreetMap, GTFS (circa May 2016)

> used to compute origin-destination matrices from home locations to work locations

Computing Travel Times

$t_{i,j,m}$ = travel time from i to j for a departure time m

$t_{i,j,m}$



m

$T_{i,j,m} = \{t_{i,j,m}\}$

Measuring Access to Jobs:

Common approach

$$A_i = \sum_{j=1}^{J} O_j f(t_{i,j})$$

A_i = access to jobs at location i

O_j = number of jobs at location j

$f(t_{i,j})$ = gravity function

Accounting for competition

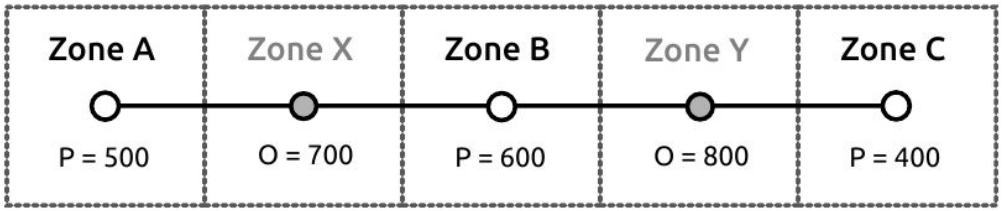
$$A_i = \sum_{j=1}^{J} \frac{O_j f(t_{i,j})}{L_j}$$

$$L_j = \sum_{i=1}^{I} \frac{P_i f(t_{i,j})}{A_i}$$

L_j = access to the labour force from j

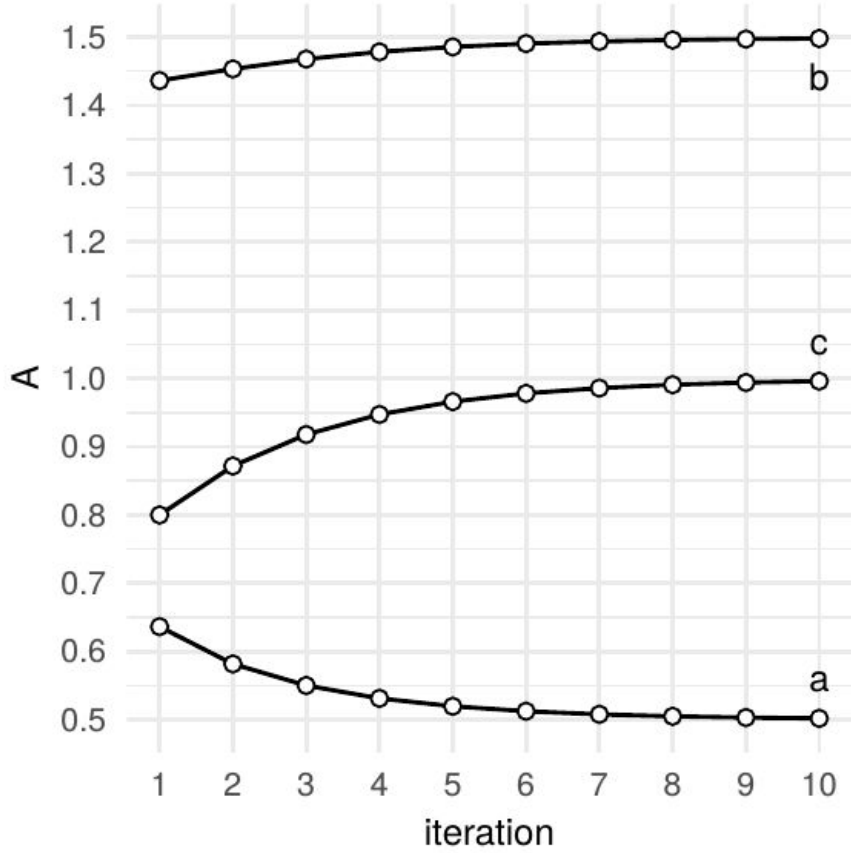
P_i = number of workers at location i

Simulation:



$$A_i = \sum_{j=1}^{J} \frac{O_j f(t_{i,j})}{L_j}$$

$$L_j = \sum_{i=1}^{I} \frac{P_i f(t_{i,j})}{A_i}$$



Accounting for mode and any imbalance in the number of jobs and the size of the labour force

$$A_{i,\lambda} = \frac{\bar{A}_0}{\bar{A}_c} \sum_{j=1}^{J} \frac{O_j f(t_{i,j,\lambda}) f(t_{i,j,\lambda})}{L_j}$$

$$L_j = \sum_{\forall \lambda \in \Lambda} \sum_{i=1}^{I} \frac{\alpha_{i,\lambda} P_i f(t_{i,j,\lambda})}{A_{i,\lambda}}$$

A_i = access to jobs at location i

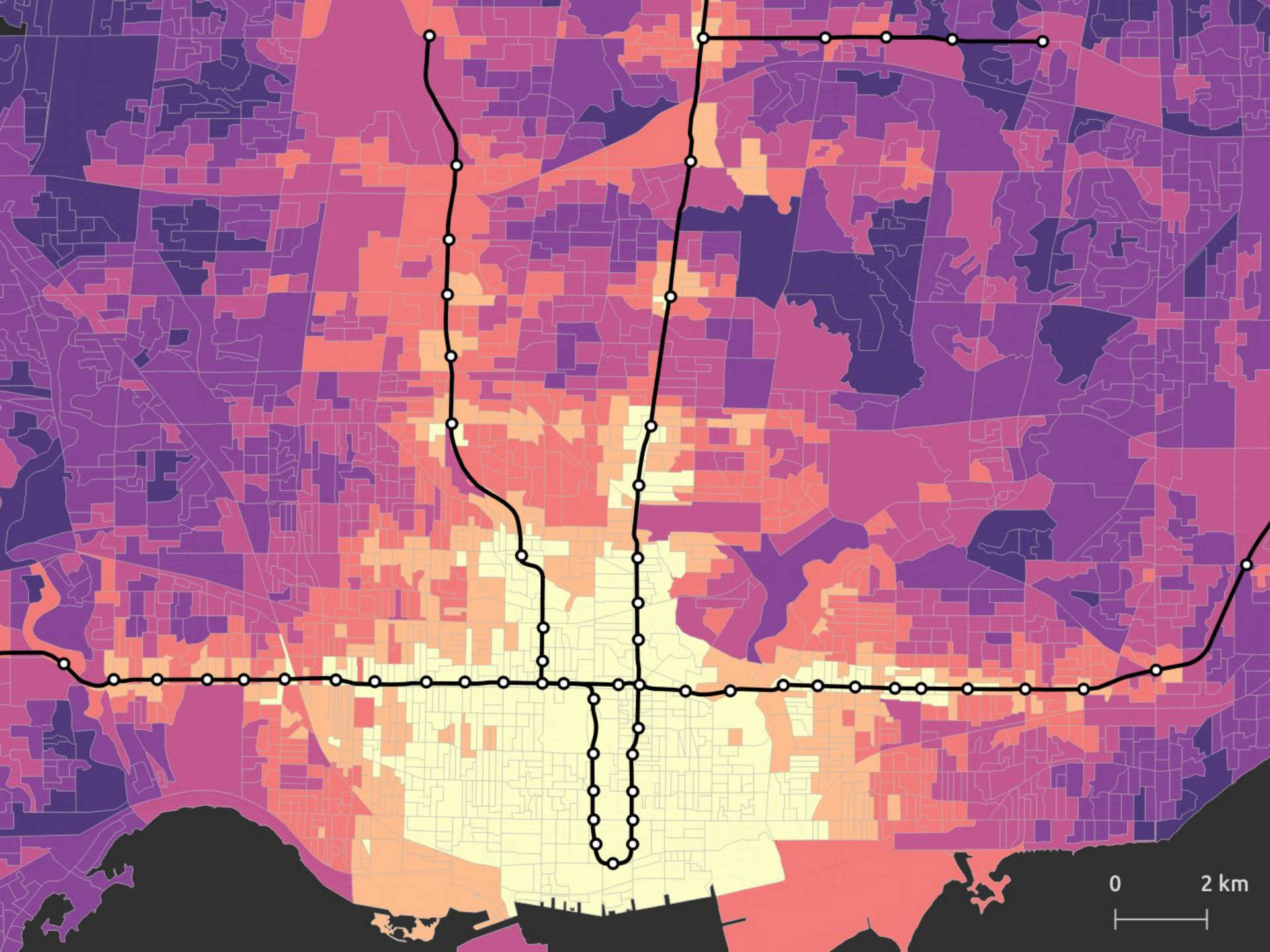
O_j = number of jobs at location j

$f(t_{i,j})$ = gravity function

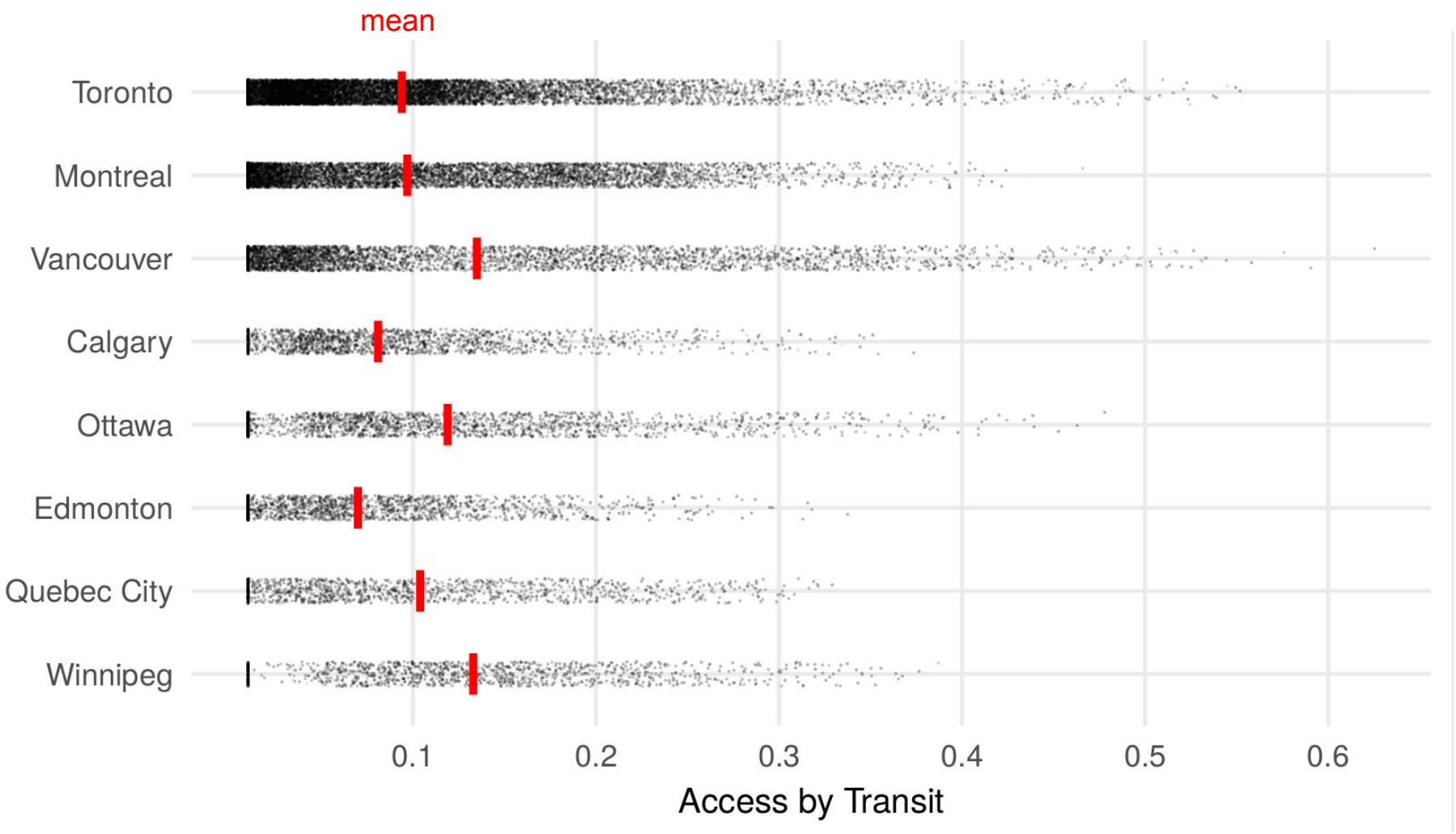
L_j = access to the labour force from j

P_i = number of workers at location i

λ = travel mode


0
2 km

Summary of Transit Access by Region

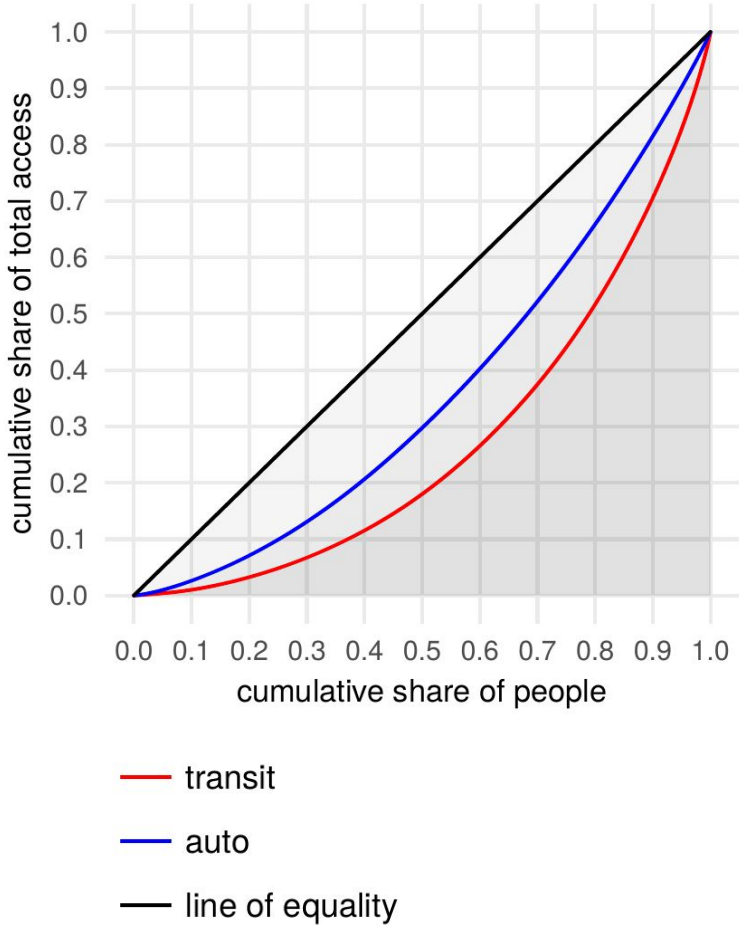


Inequalities of Transit Access

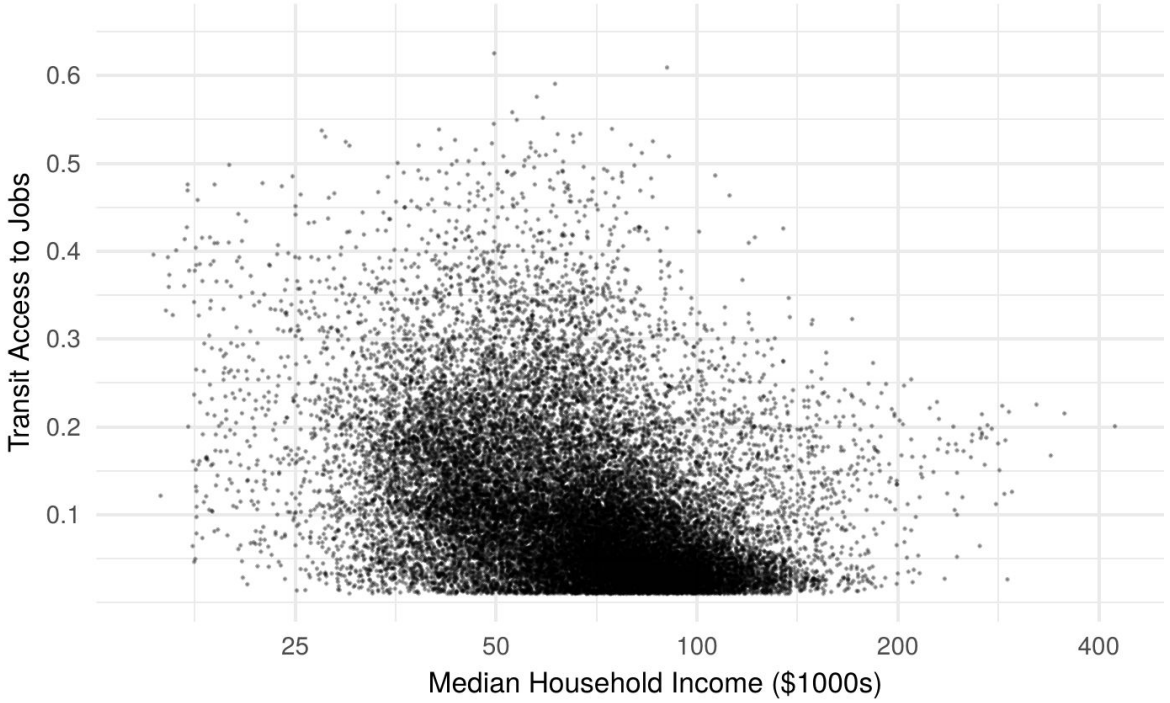
Gini Coefficient:

	Transit Access	Auto Access
Toronto	0.493	0.305
Montreal	0.499	0.317
Vancouver	0.510	0.317
Calgary	0.454	0.208
Ottawa	0.416	0.240
Edmonton	0.458	0.193
Quebec City	0.416	0.174
Winnipeg	0.325	0.134
All	0.489	0.289

Lorenz Curve



Transit Access & Income:



	correlation coefficient
All	**-0.37**
Toronto	-0.29
Montreal	-0.48
Vancouver	-0.38
Calgary	-0.36
Ottawa	-0.38
Edmonton	-0.53
Quebec City	-0.57
Winnipeg	-0.64

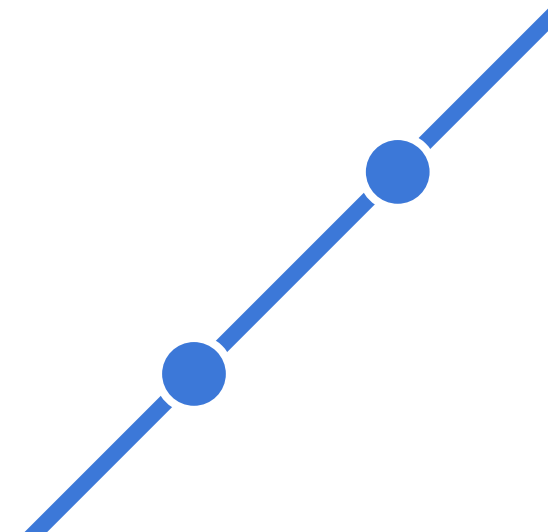
Transit Access & Income:

In the lowest quintile of transit access there are ….

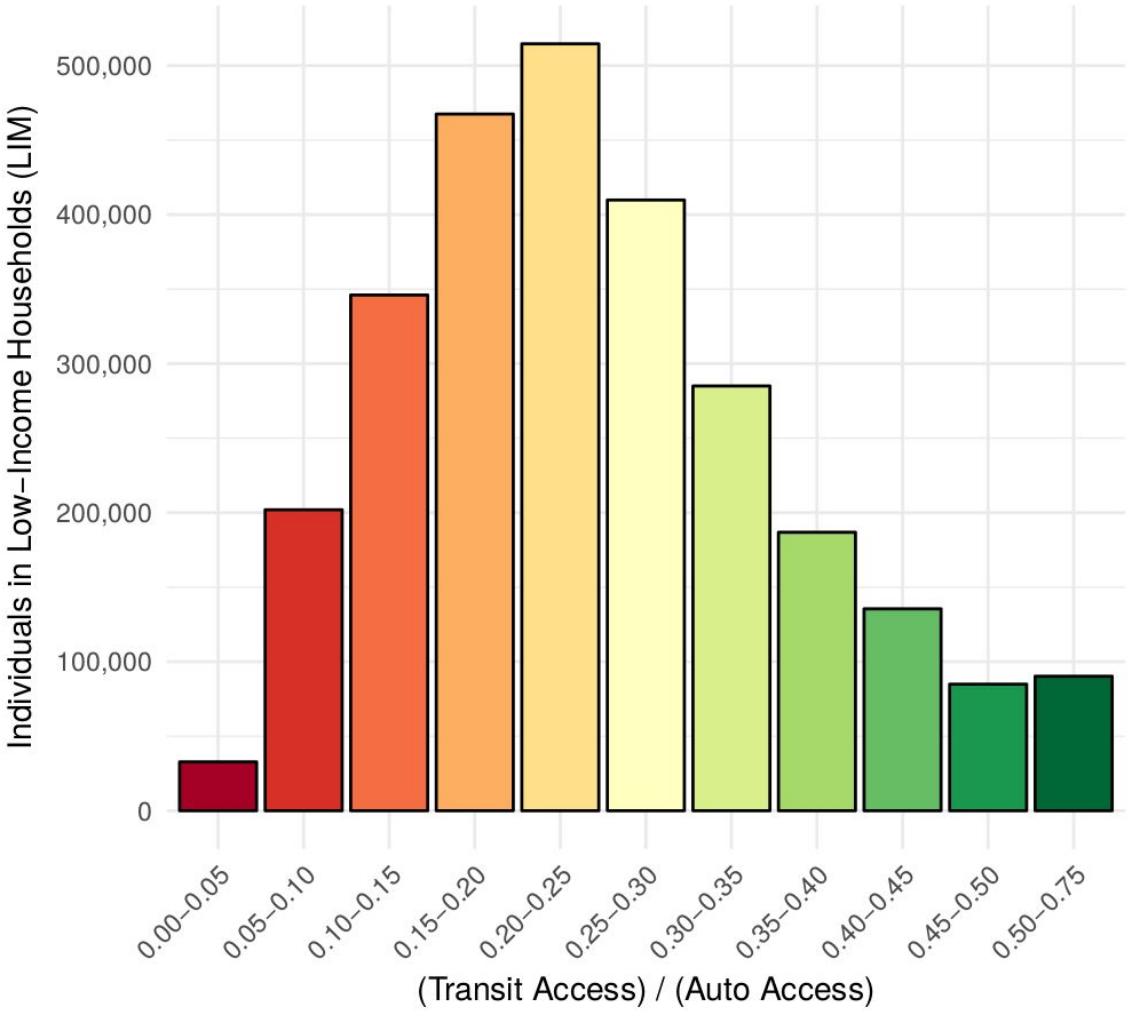
300,000 people living below the poverty line

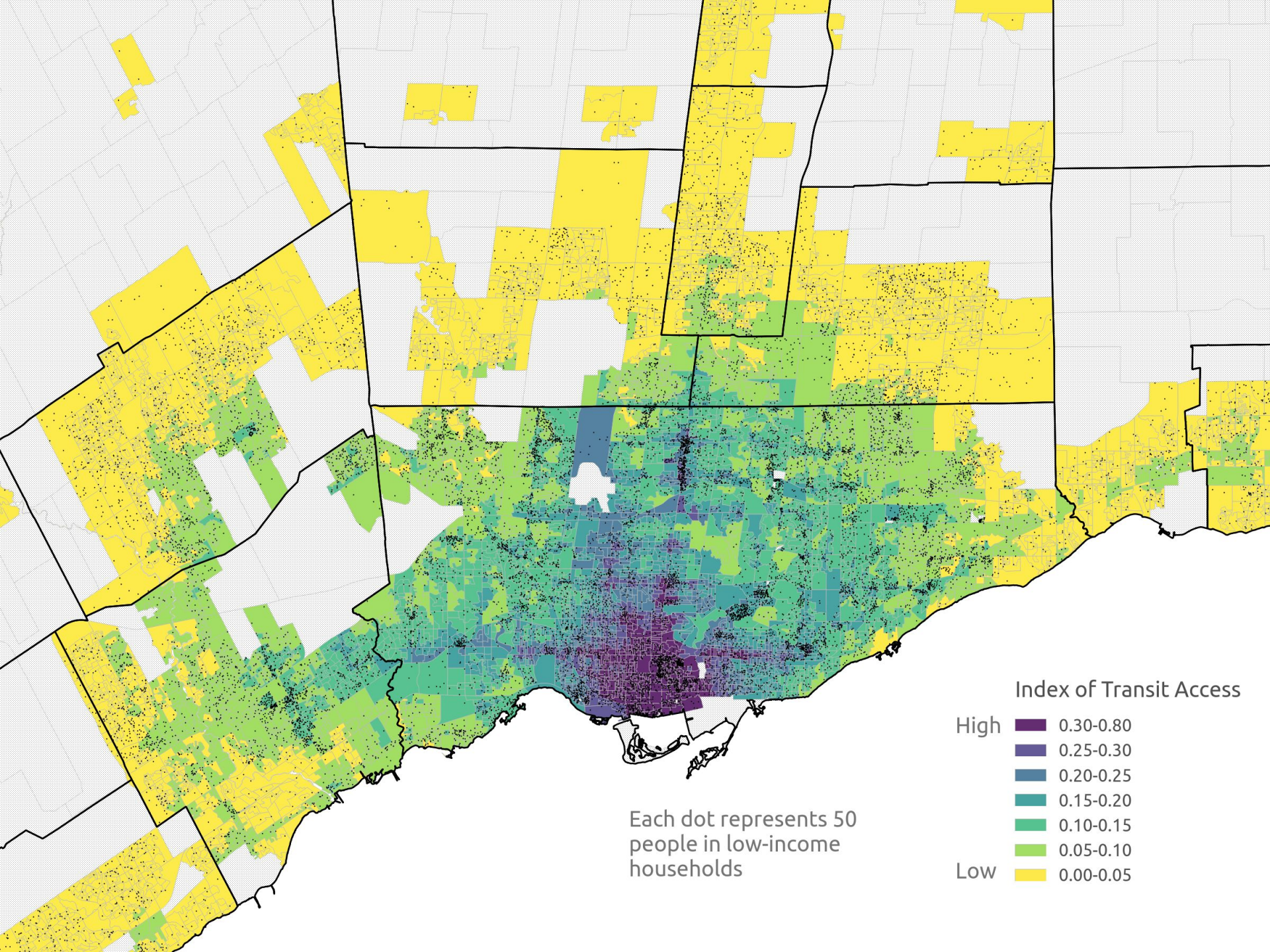
125,000 people who are unemployed

110,000 recent immigrants (2011-2016)



Transit Access & Income:



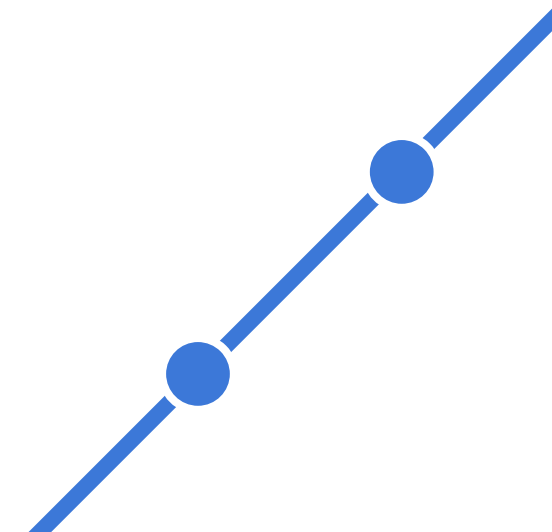

Index of Transit Access
High
0.30-0.80
0.25-0.30
0.20-0.25
0.15-0.20
0.10-0.15
0.05-0.10
Low
0.00-0.05
Each dot represents 50 people in low-income households

Policy Implications:

+ Focus suburban transit investments in areas which have relatively low socio-economic status and low transit access.

+ Promote higher density land-use planning to help reduce travel times between activity locations

+ Consider demand responsive transit or subsidized rideshare programs in areas with smaller populations



Conclusion:

Link for code and slides:

https://github.com/SAUSy-Lab/canada-transit-access

Contact:

jeff.allen@mail.utoronto.ca

Work supported by a grant from the Ontario Ministry of Research, Innovation, and Science and a SSHRC Master's scholarship

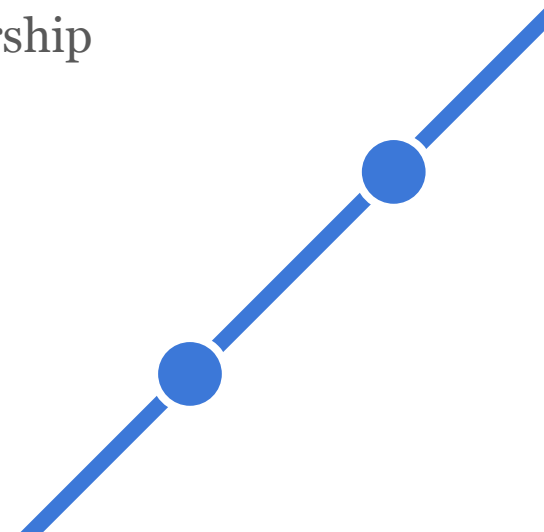


Table 1: Summary statistics by urban region

	Area (km^2)	Population	Jobs[§]	Labour Force[§]	Transit Mode Share[†]	Mean Commute Time[*]	
						Auto	Transit
Toronto	12,160	7,951,192	3,462,185	4,524,570	18.4%	29.0	49.2
Montreal	4,605	4,098,927	1,757,150	2,189,115	22.2%	26.8	44.4
Vancouver	4,935	2,745,461	1,091,340	1,498,535	18.7%	27.2	43.8
Calgary	5,110	1,392,609	587,290	816,385	15.9%	24.1	41.6
Ottawa	6,770	1,323,783	595,920	727,160	20.1%	24.7	42.2
Edmonton	9,440	1,321,426	553,660	758,150	11.3%	24.2	40.2
Quebec City	3,410	800,296	375,750	437,325	11.3%	21.2	35.1
Winnipeg	4,310	778,489	344,330	424,250	13.4%	22.6	35.7

[†] Percent of work commute trips by transit

[*] In minutes

[§] Jobs are only those in the region with a "usual place of work" according to the census, while the labour force also includes the unemployed, those who work at home, and those without a fixed place of work.