PLANNING FOR TRANSIT EQUITY IN THE GTHA: QUANTIFYING THE ACCESSIBILITY-ACTIVITY PARTICIPATION RELATIONSHIP FOR LOW-INCOME HOUSEHOLDS

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BOUNDLESS

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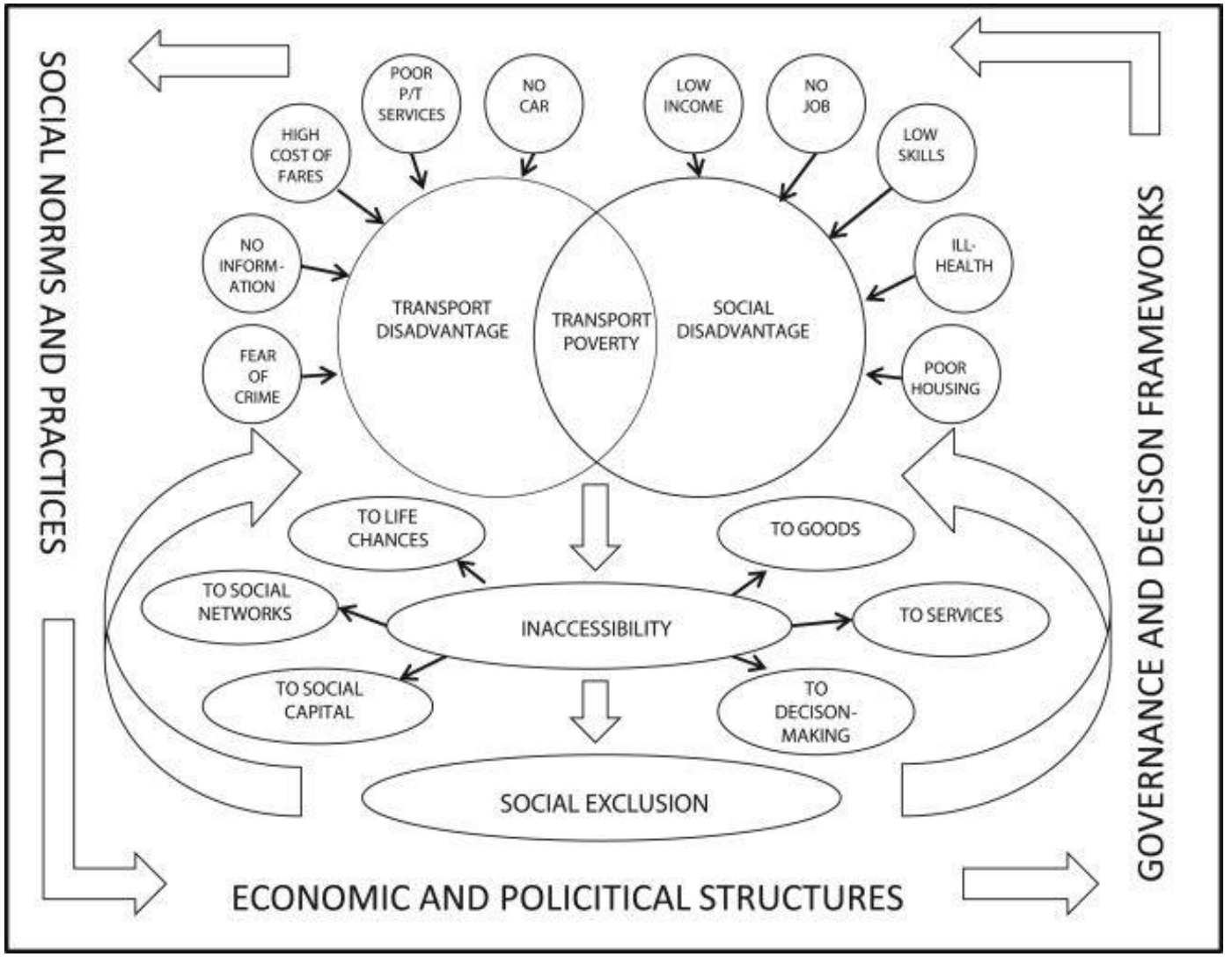
BACKGROUND AND OBJECTIVES

BACKGROUND

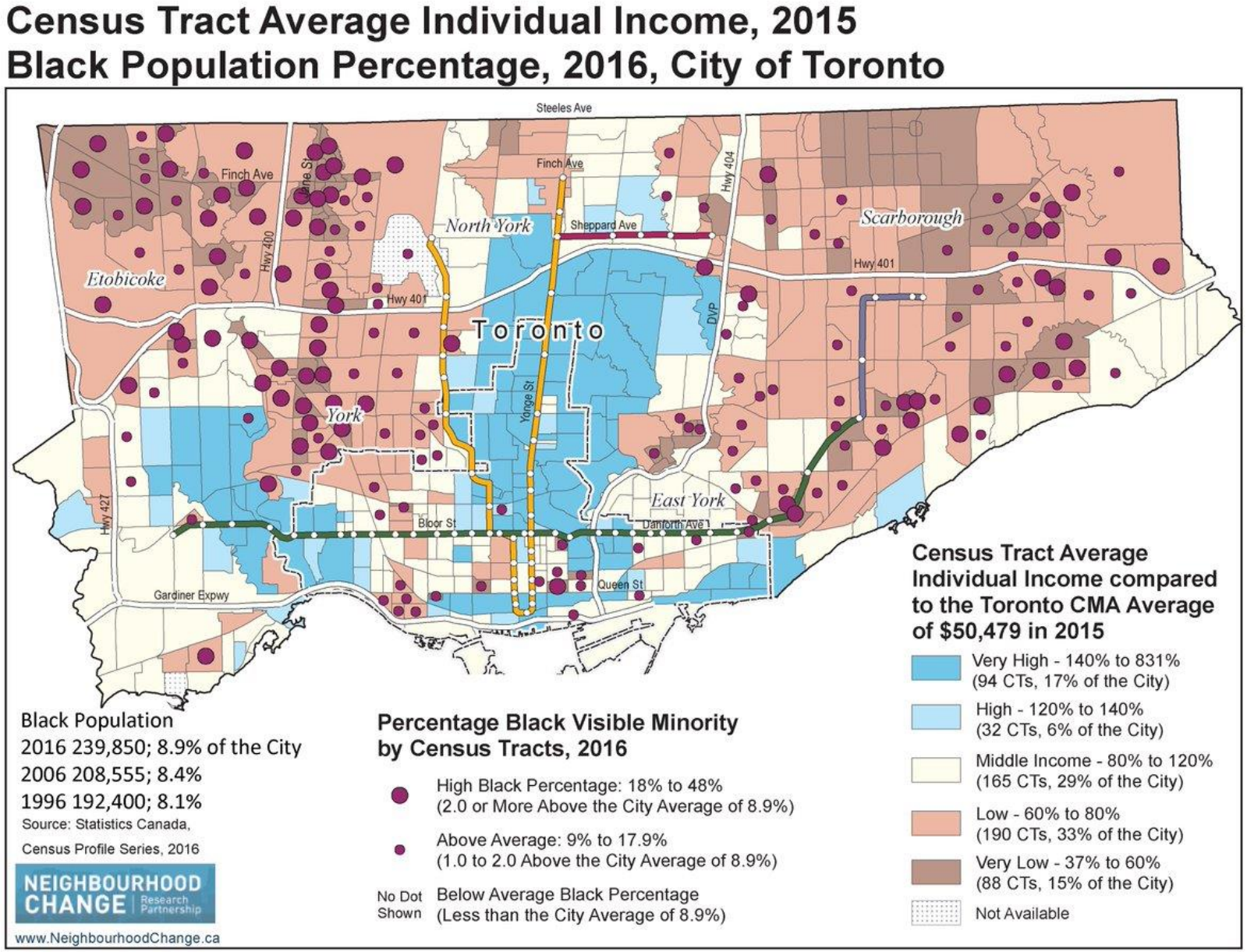
- Despite transport plans often stating equity objectives, transport planning models tend not to include explicit equity measurements
- Equity is difficult to conceptualize and measure, and there is a debate over whether or how we should value projects that increase equity
- Literature warns us about the social costs of unequal transport provision:
  - Suppressed demand for travel
  - Transport-related Social Exclusion
- Socioeconomic disadvantage is growing in automobile dependent (inner and outer) suburbs
- We argue that transport evaluations should capture impacts on “unlocking” out of home activity participation

TRANSPORT AND SOCIAL EXCLUSION



Lucas, K. (2012). Transport and social exclusion: Where are we now?. *Transport policy*, *20*, 105-113.

GROWING LEVELS OF INCOME POLARIZATION AND SEGREGATION



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STUDY OBJECTIVES

1. Compute a set of metrics for benchmarking the state of transport equity in the GTHA

2. Identify “Participation Deserts” – Where transport poverty is observed to suppress activity participation

3. Quantify the effect of public transit provision on activity participation

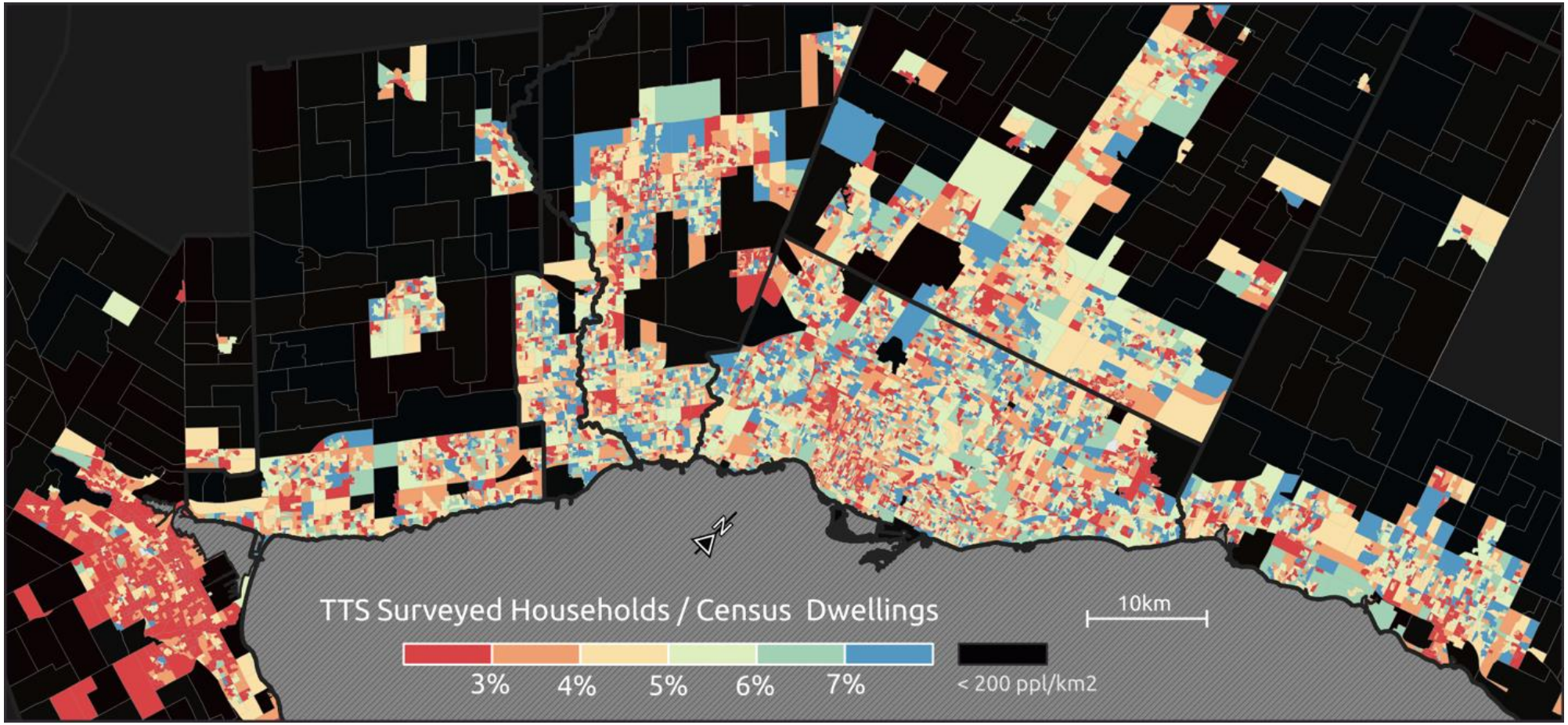
4. Estimate the value of “equity” through the lens of inducing heightened activity participation

DATA CONSIDERATIONS

DATA SOURCES

- Transportation Tomorrow Survey 2016
- Census job counts (and income)
- Street network files
- GTFS Packages for all transit agencies in the GTHA

TTS SAMPLING

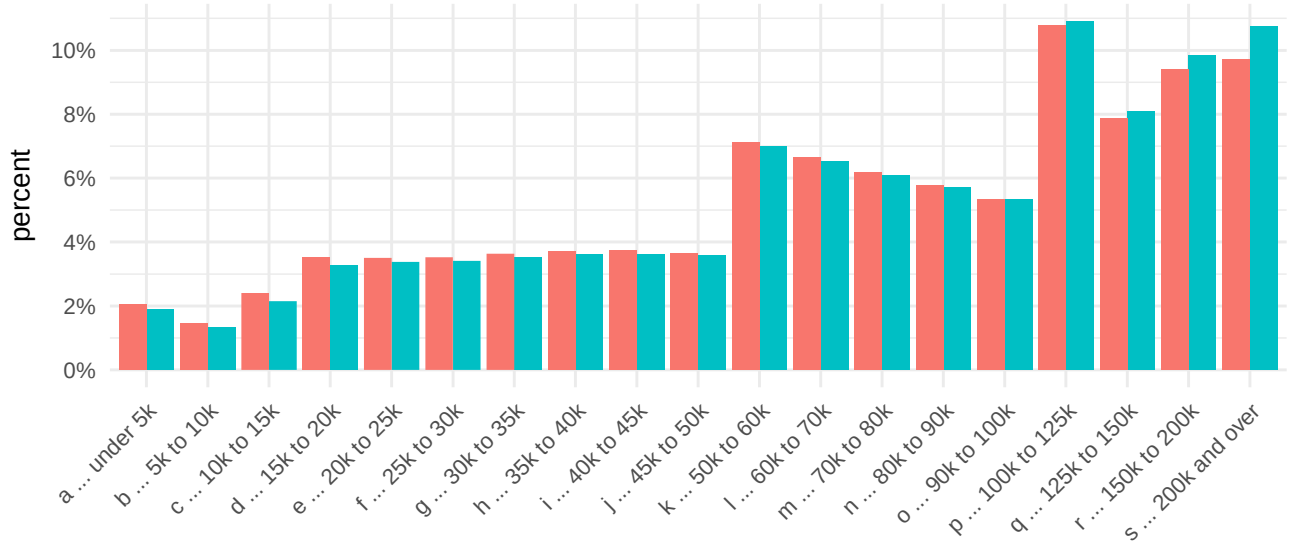


INCOME NON-RESPONSE (18%)

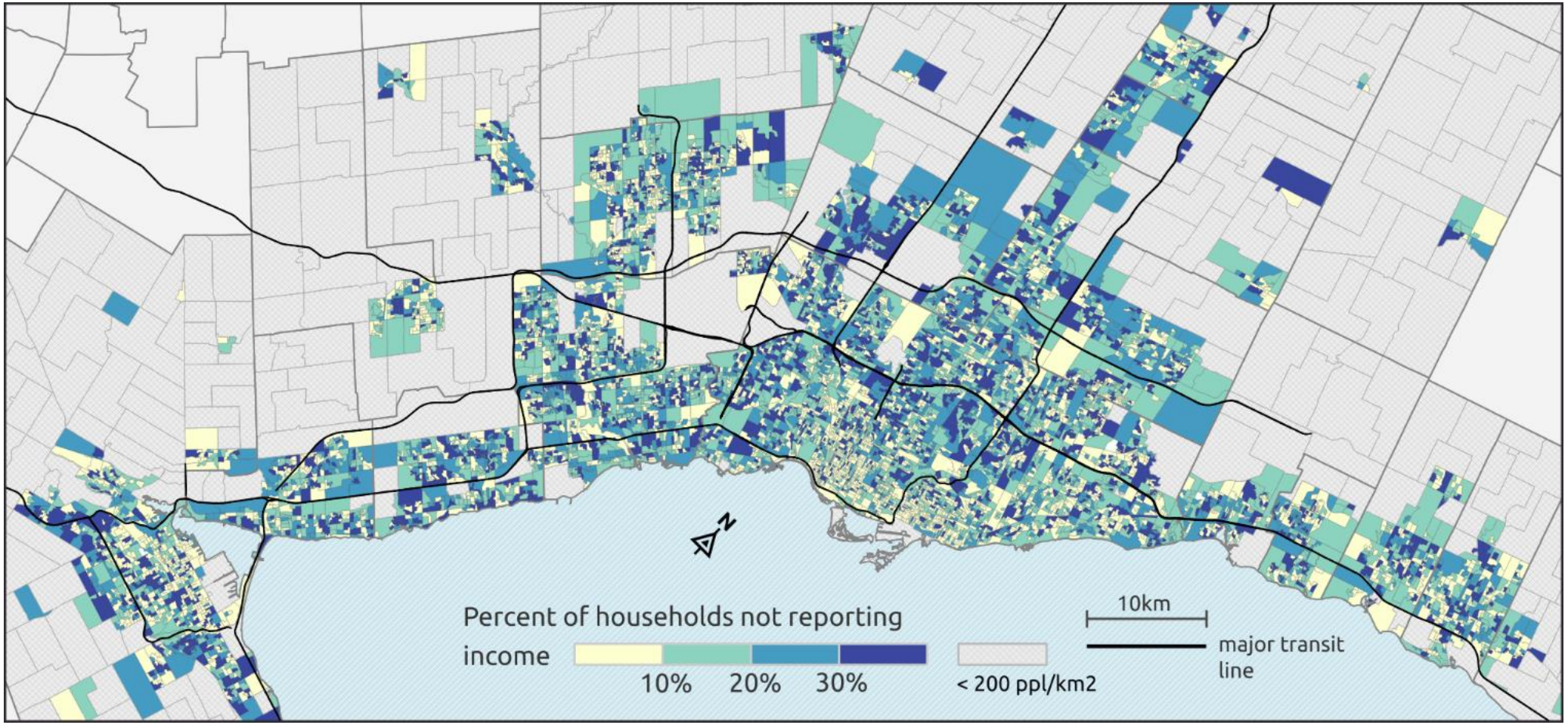
- Internal Validation: Compared demographics between those with and without income

	Responded to Income	Did not Provide Income
65 Years and Older	14.6%	21.4%

- External Validation: Compared overall census based income distribution (red) to the distribution of census income for only the missing income responses (blue)



INCOME NON-RESPONSE: SPATIAL PATTERNS

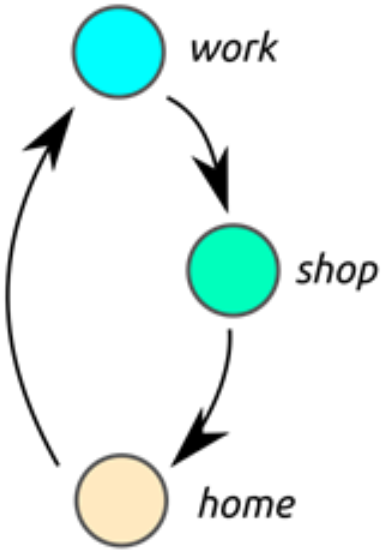


INCOME NON-RESPONSE

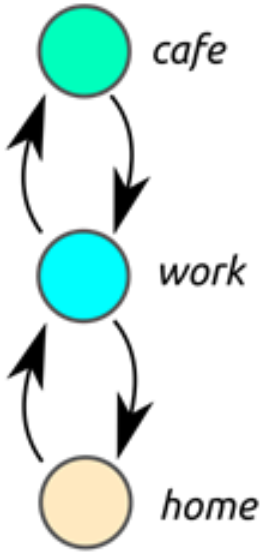
- Imputing income was deemed beyond the scope of this project
- Decision to remove the non-response sample from analysis given
  - Internal validation revealed very few differences between those who did and did not report income
  - External validation revealed that missing income respondents matched the census-based income distribution very well
  - Non-responses are spatially random
- Caveats: Analysis sample is slightly younger and potentially slightly poorer than population.

QUANTIFYING PARTICIPATION USING THE TTS

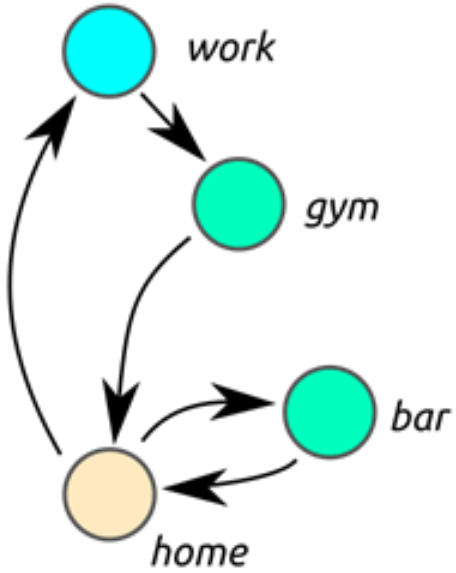
2 trips
1 activity
0 discretionary activities



3 trips
2 activities
1 discretionary activity



4 trips
2 activities
1 discretionary activity



5 trips
3 activities
2 discretionary activities

QUANTIFYING ACCESSIBILITY

- Access to Jobs taken as a proxy for access to both employment as well as other activity destinations (services, retail, etc.)

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

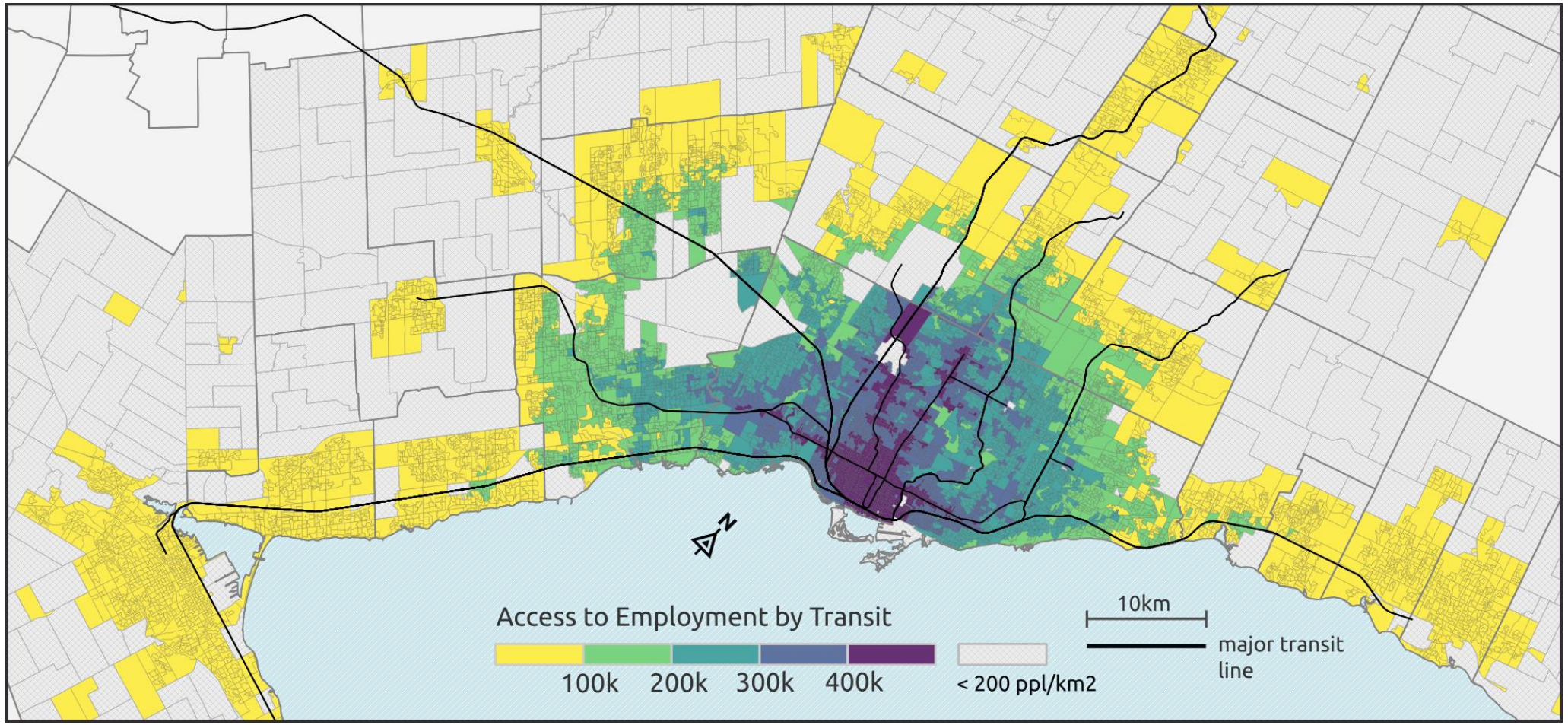
Where O_j are the jobs at location j taken from Journey-to-Work 2016 NHS

t_{ij} is the travel time from DA i to CT j

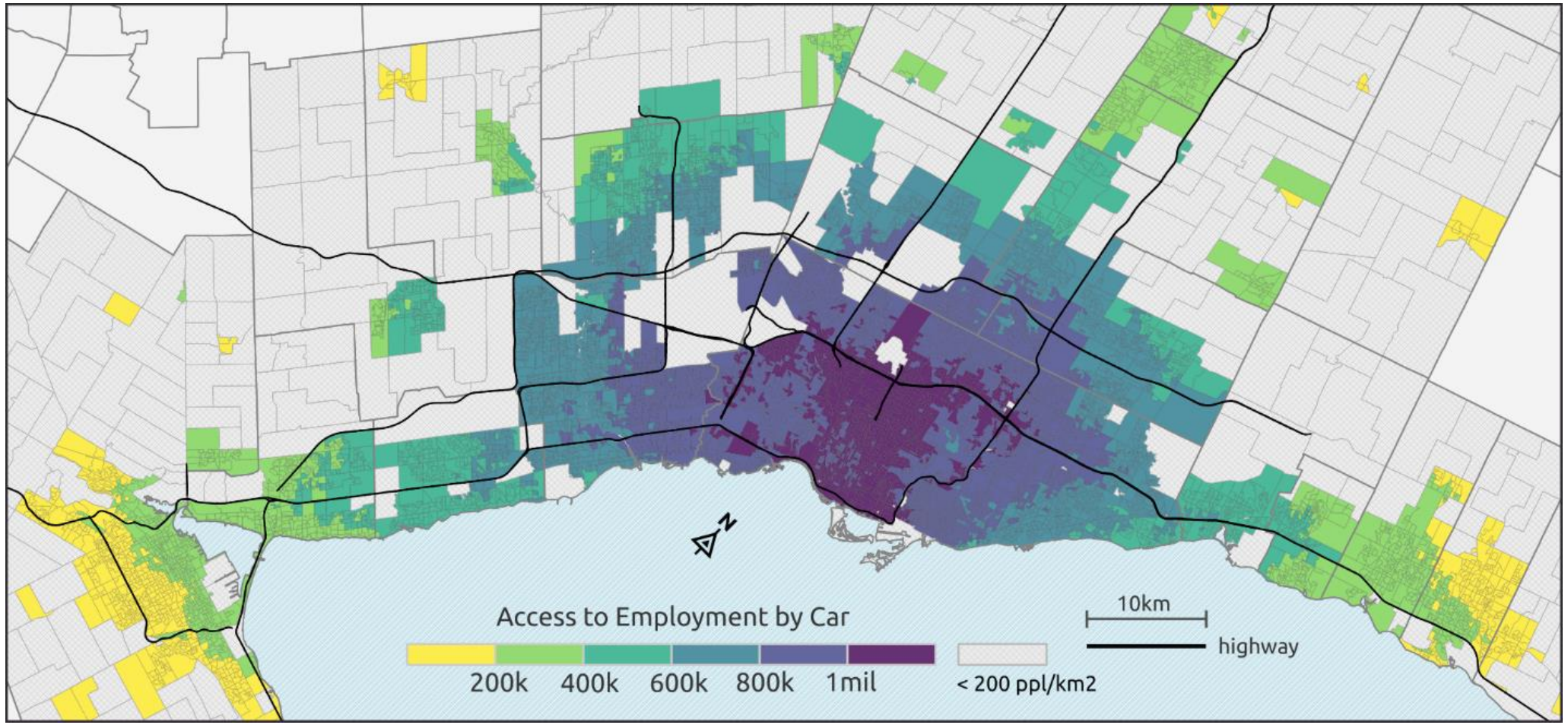
- For transit: average travel time over morning commute period
- For vehicle: Free-flow multiplied by congestion factor of 1.7

$f(t_{i,j}) = 180(90 + t_{i,j})^{-1} - 1$ is decay function with 0.5 weight at 30 minutes, and 0 weight at 90 minutes.

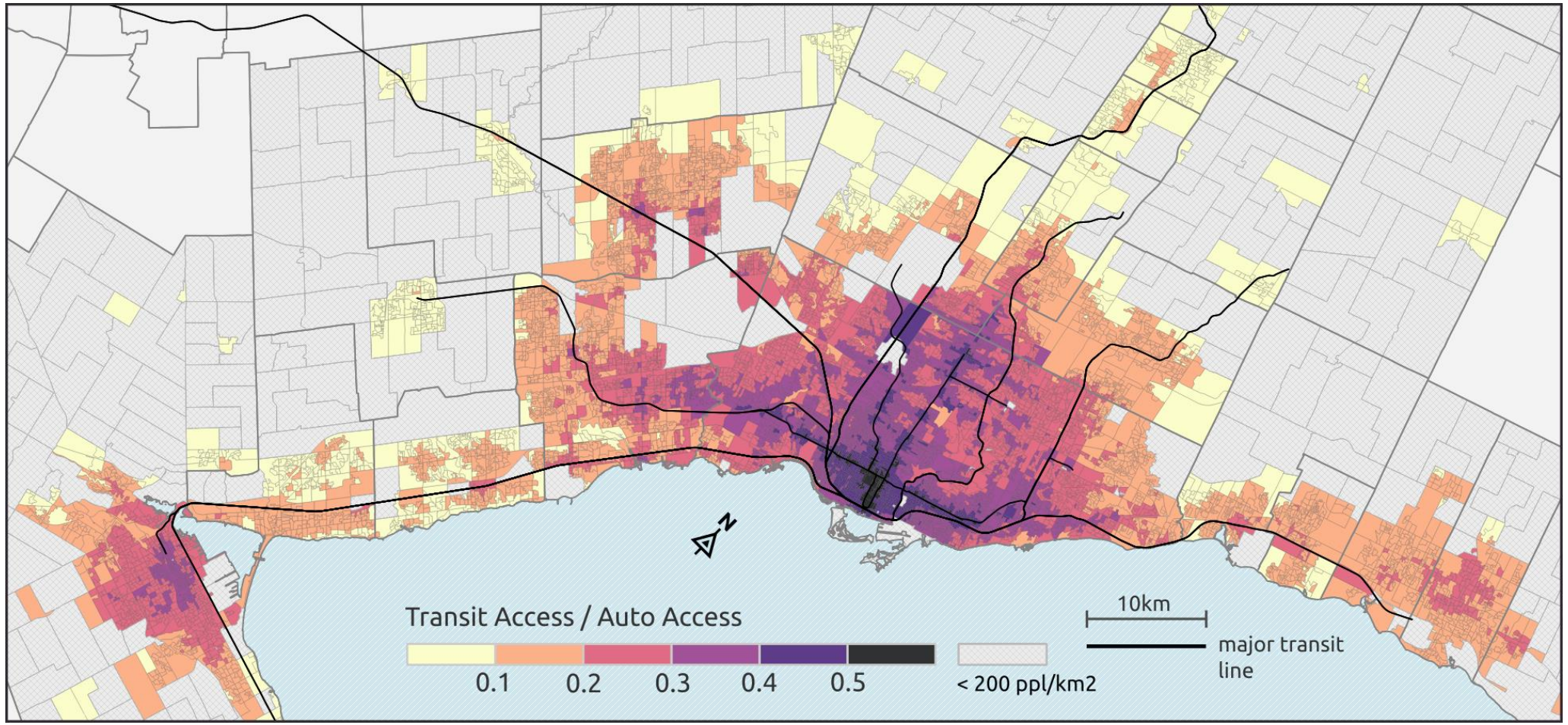
ACCESS TO JOBS – TRANSIT



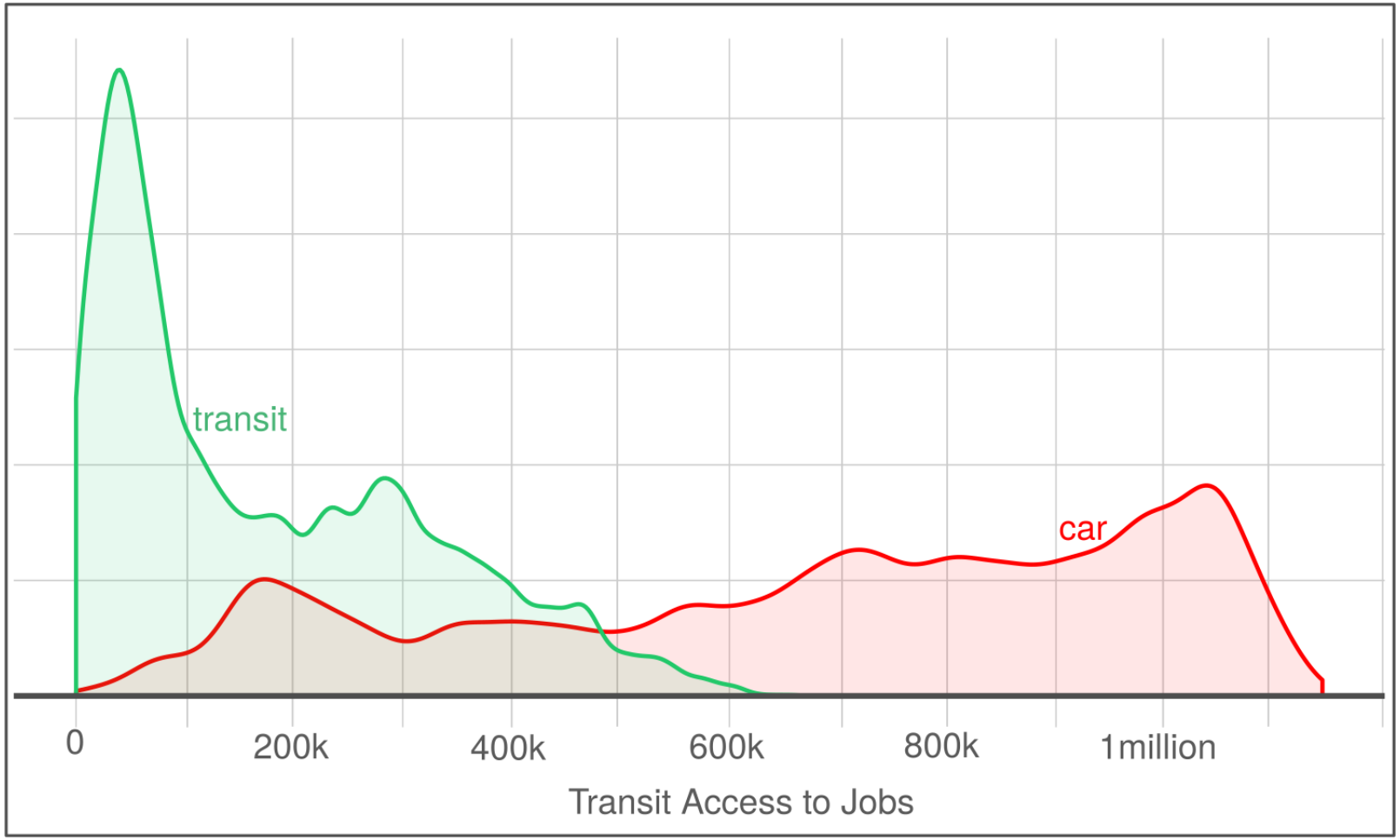
ACCESS TO JOBS – AUTOMOBILE



ACCESS TO JOBS: RATIO OF TRANSIT TO AUTOMOBILE

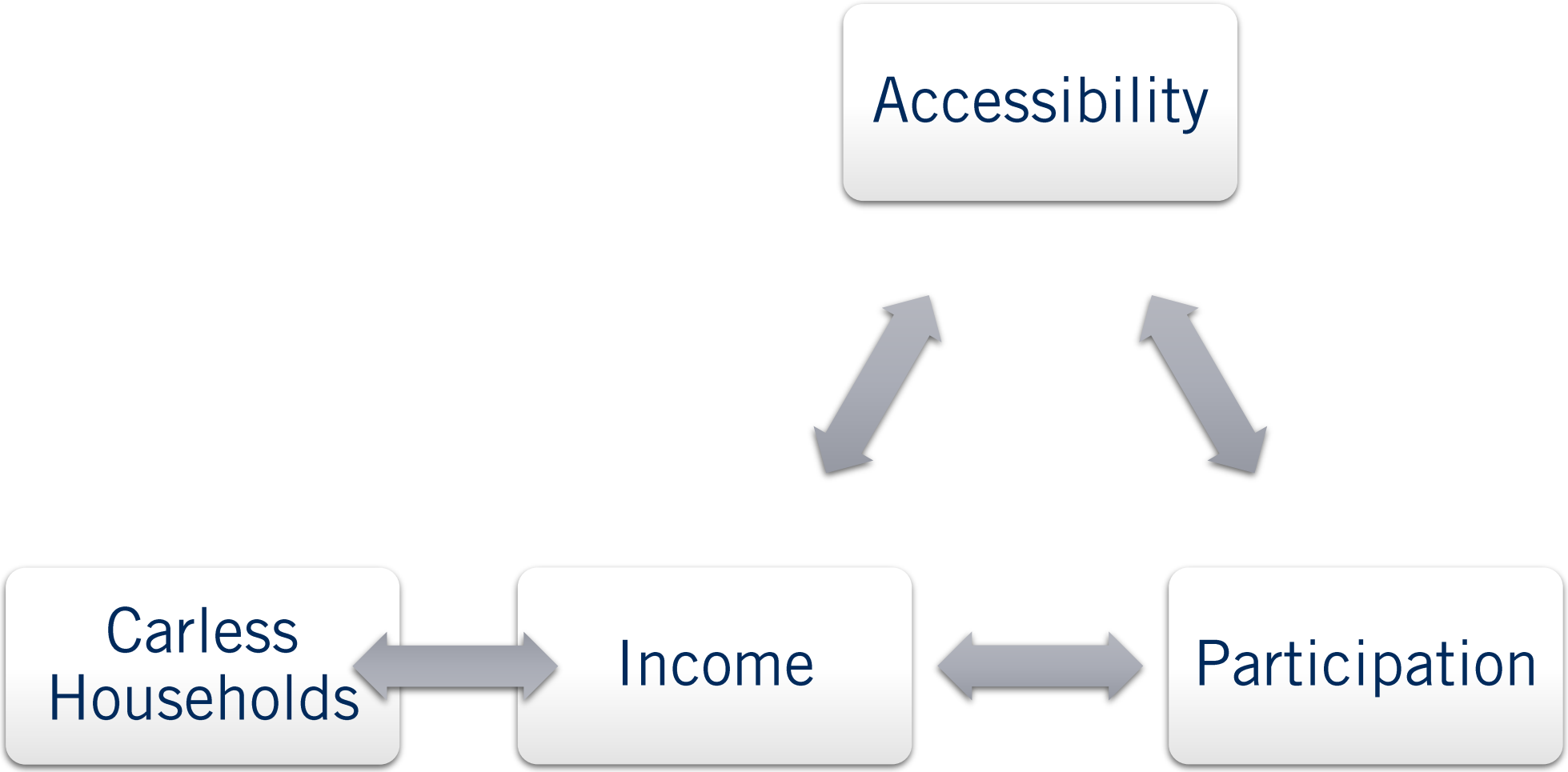


ACCESSIBILITY DISTRIBUTIONS – TRANSIT AND CAR



DESCRIPTIVE STATISTICS

BIVARIATE RELATIONSHIPS

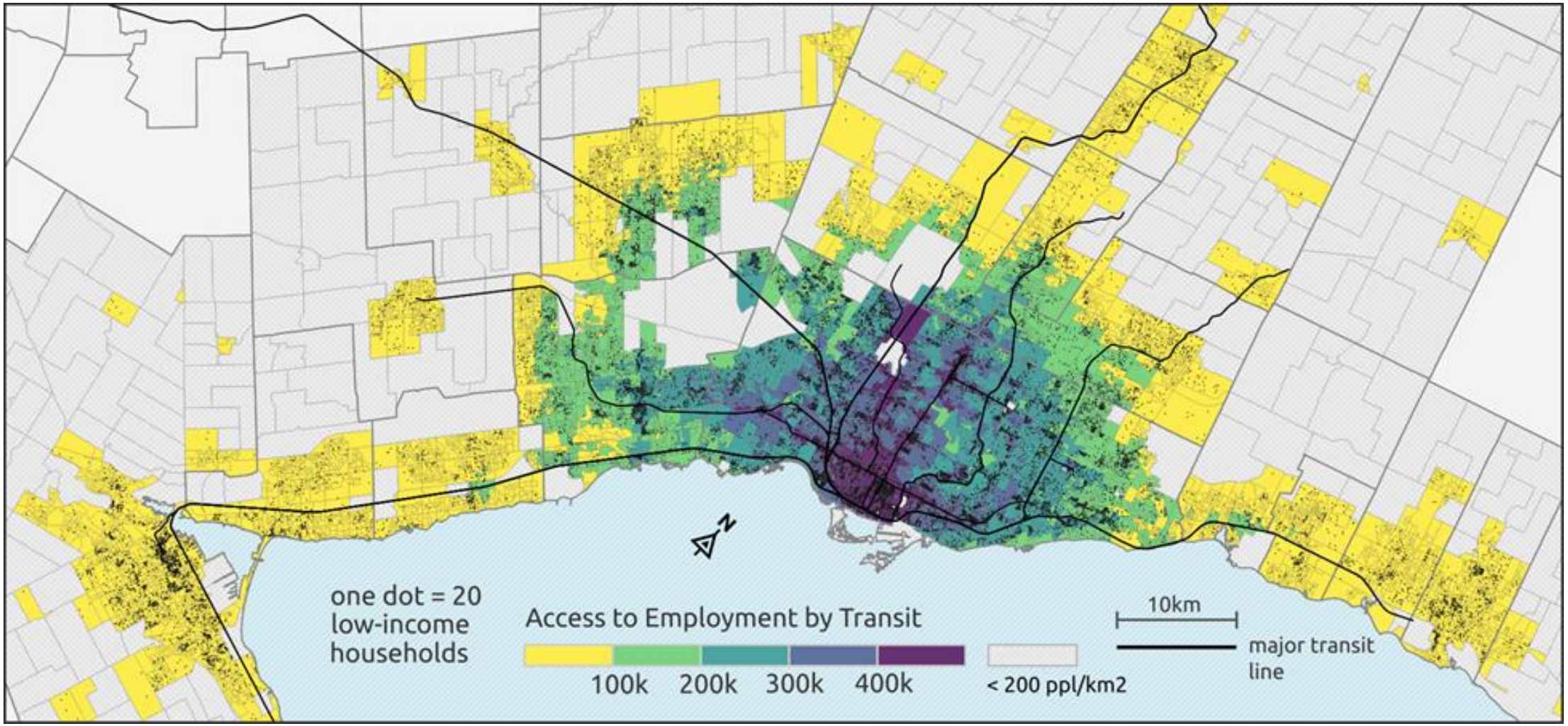


INCOME AND TRANSIT ACCESSIBILITY

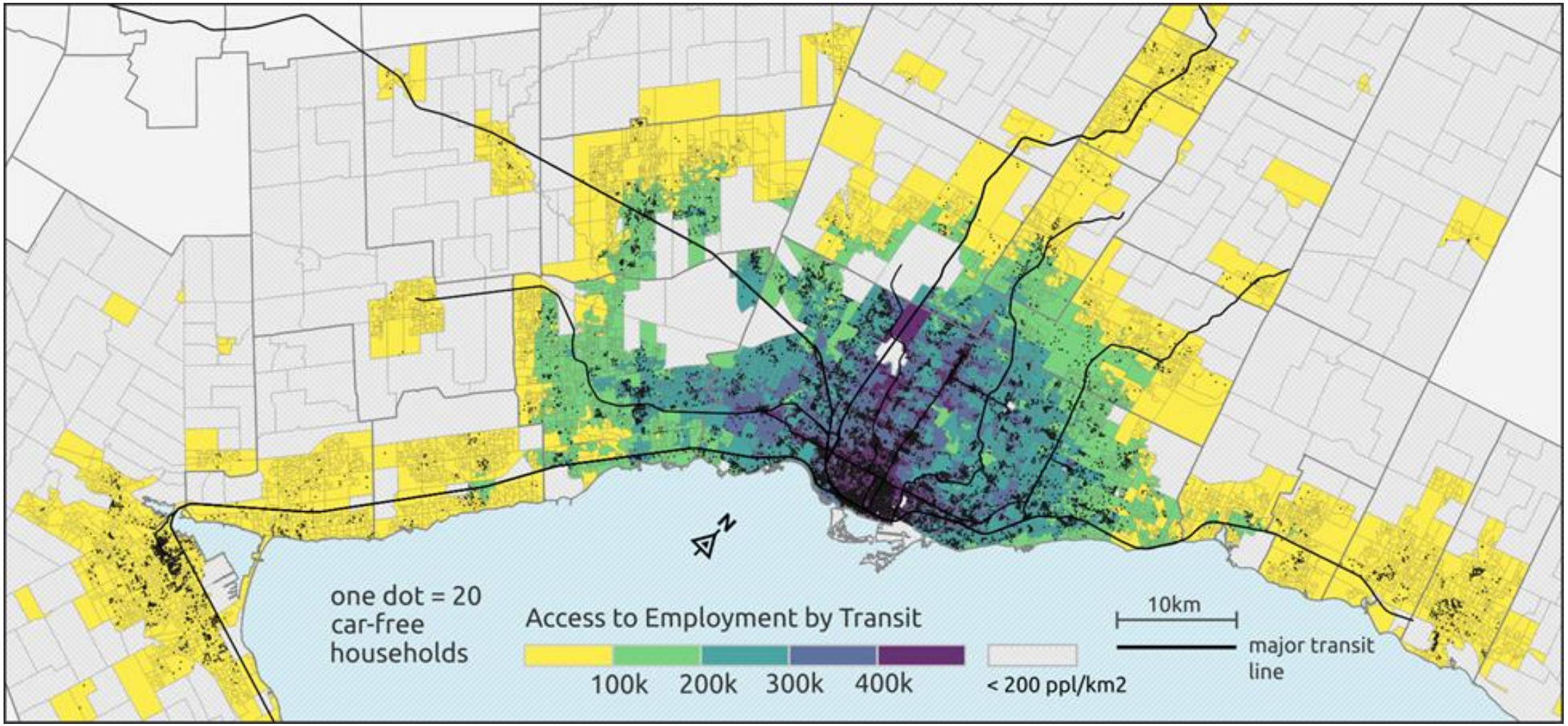
Household Income	Overall Mean Access	Carless Mean Access
$0 to $14,999	243,001	288,995
$15,000 to $39,999	204,691	282,940
$40,000 to $59,999	182,779	333,489
$60,000 to $99,999	175,607	386,137
$100,000 to $124,999	161,301	419,985
$125,000 and above	165,311	445,736

- Low-income households have higher access than wealthier households
- Carless households have higher access than car-owning households
- Wealthy carless households have much higher access than poor carless households

INCOME AND TRANSIT ACCESS



CARLESS HOUSEHOLDS AND TRANSIT ACCESS

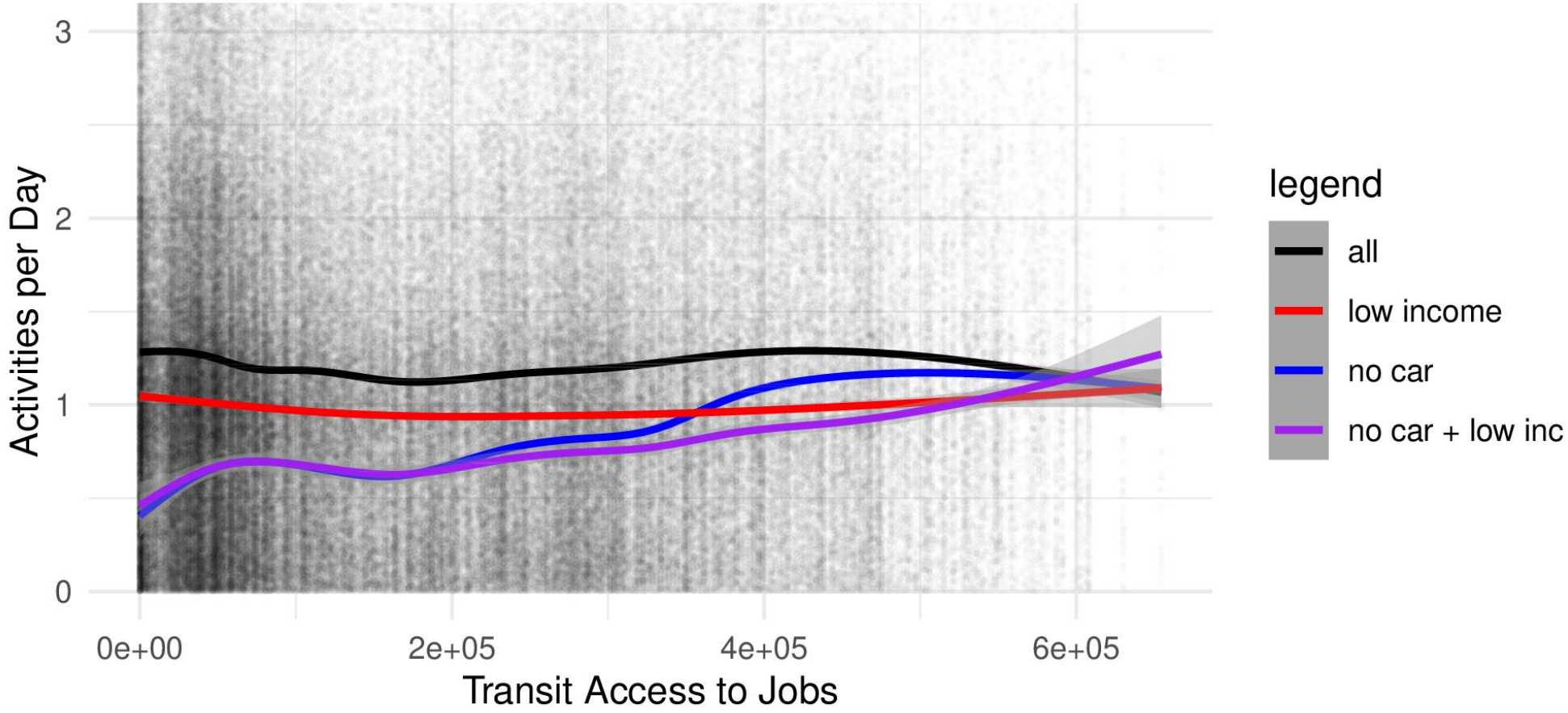


INCOME AND ACTIVITY PARTICIPATION

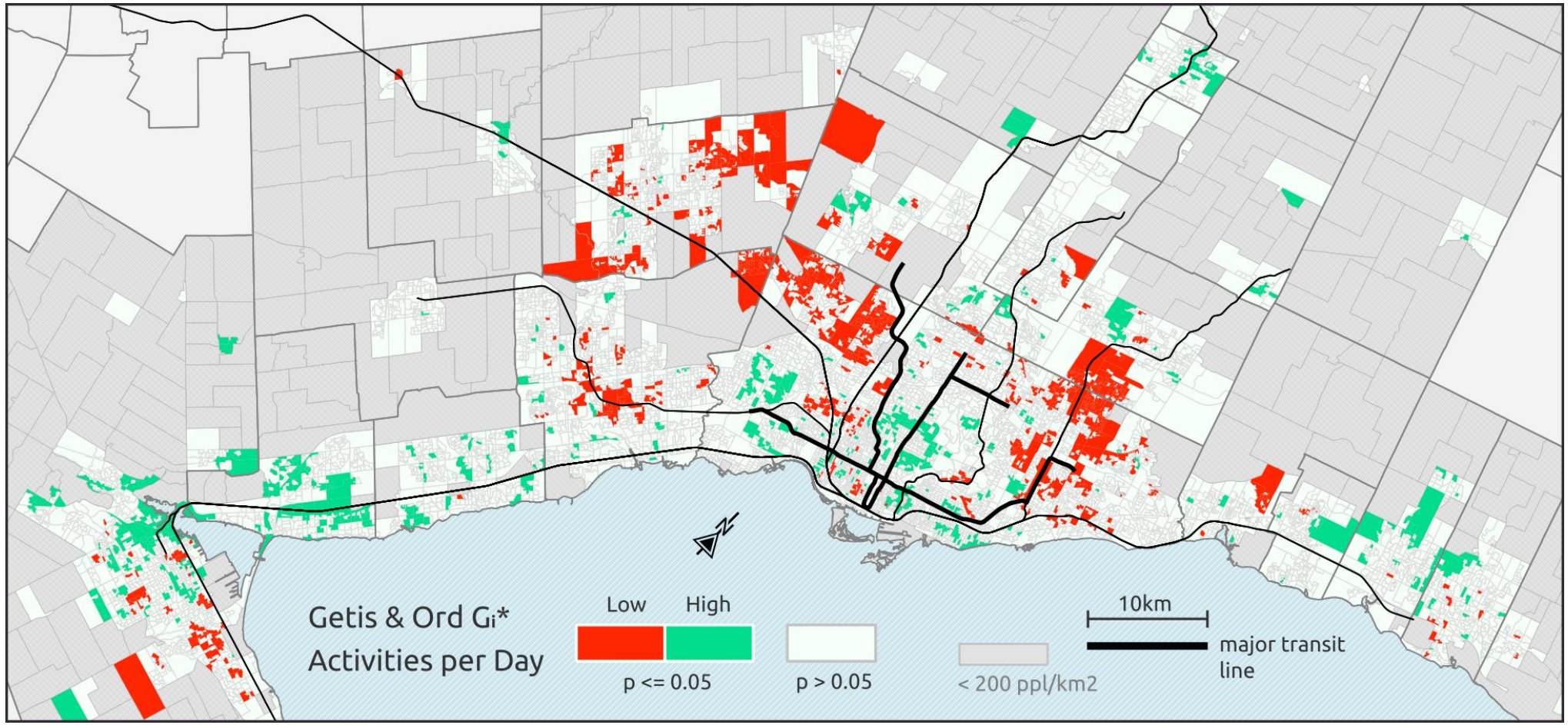
Household Income	Overall Activity Rates	Carless Activity Rates	Difference
$0 to $14,999	0.91	0.81	-11.0%
$15,000 to $39,999	1.01	0.86	-14.9%
$40,000 to $59,999	1.13	1.10	-2.7%
$60,000 to $99,999	1.24	1.21	-2.4%
$100,000 to $124,999	1.34	1.25	-6.7%
$125,000 and above	1.44	1.36	-5.6%

- Low-income households have lower participation rates than wealthier households
- Carless households have lower participation rates than car-owning households
- Effect of “carlessness” is much higher at lower income levels

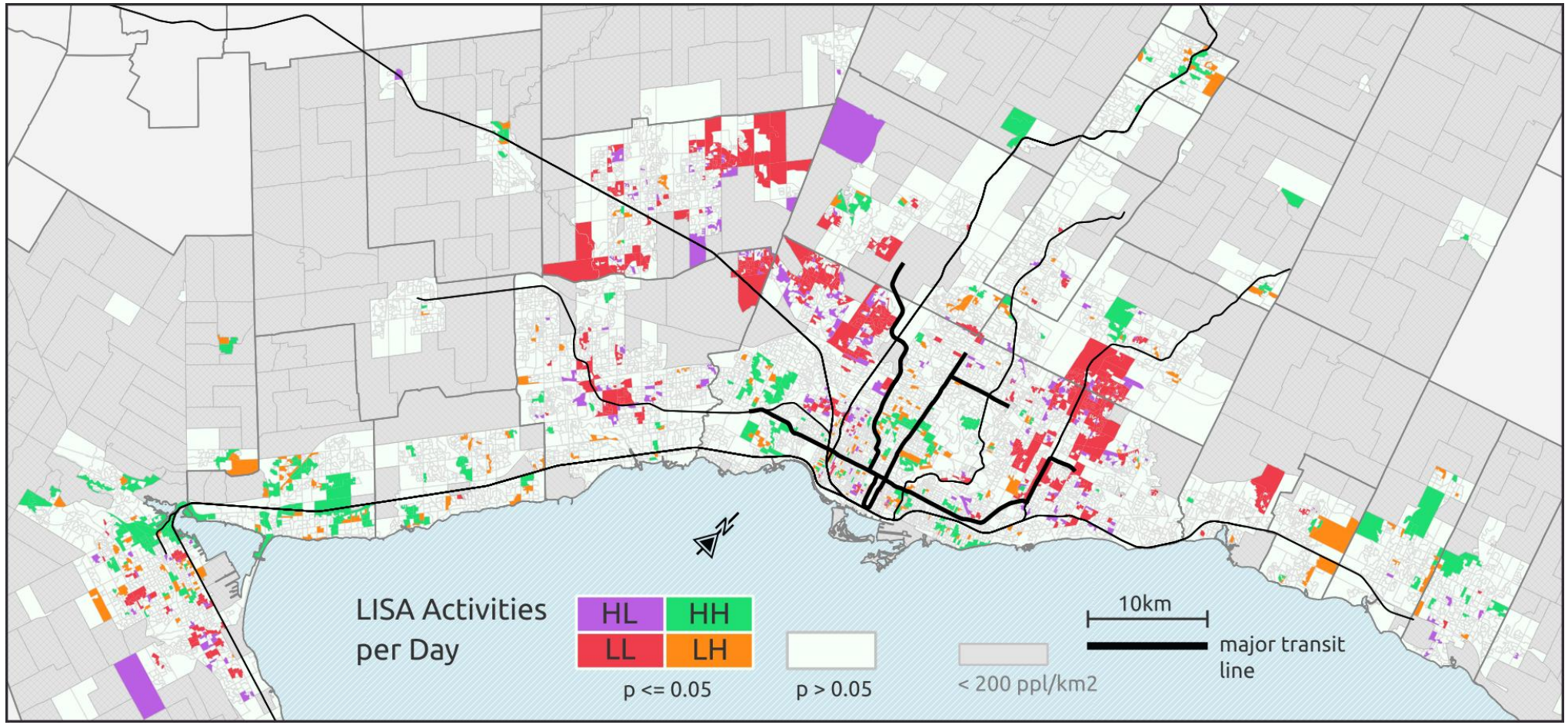
ACCESSIBILITY AND ACTIVITY PARTICIPATION



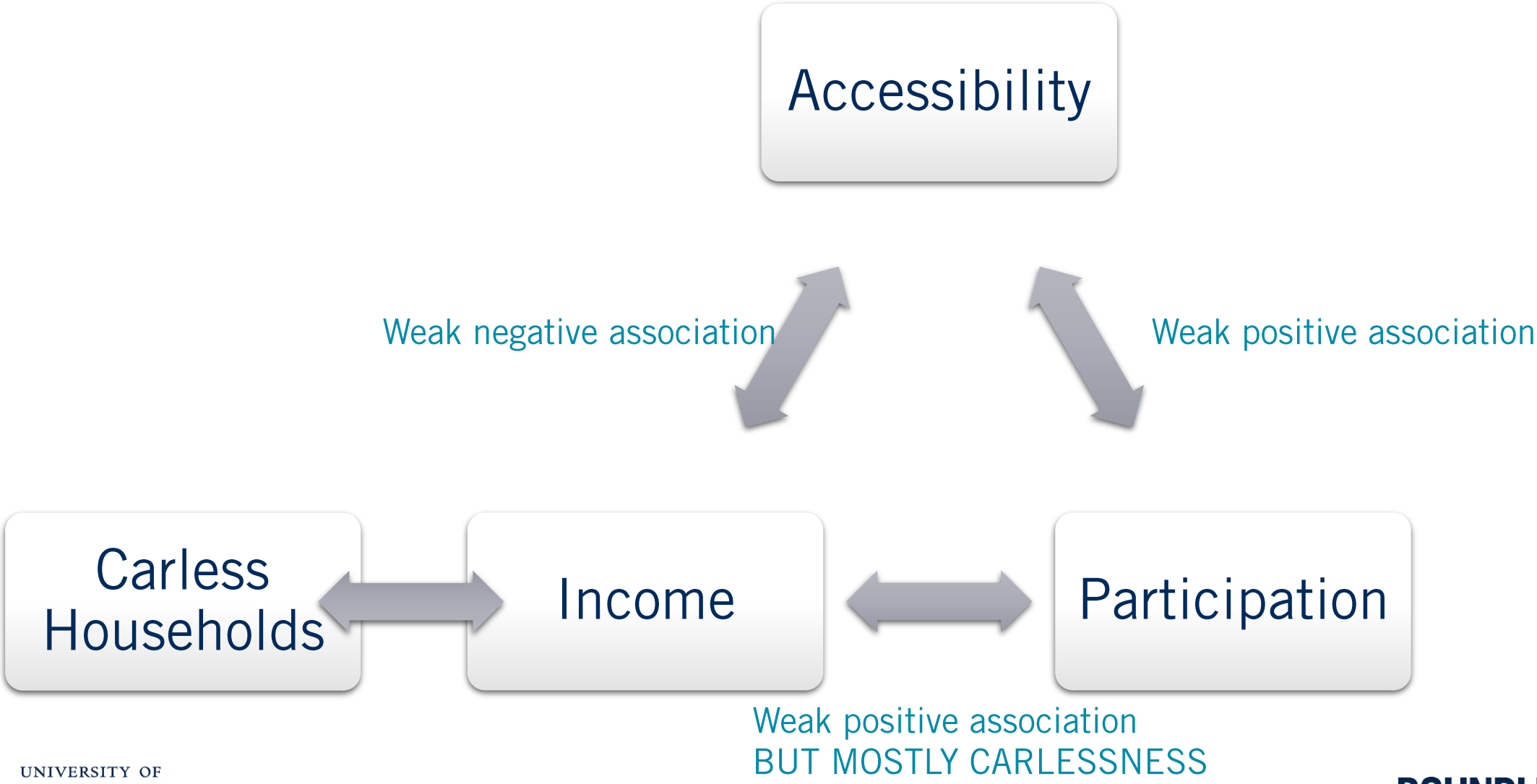
PARTICIPATION DESERTS - G_i^* STATISTIC



PARTICIPATION DESERTS – LOCAL MORAN'S I



BIVARIATE RELATIONSHIPS



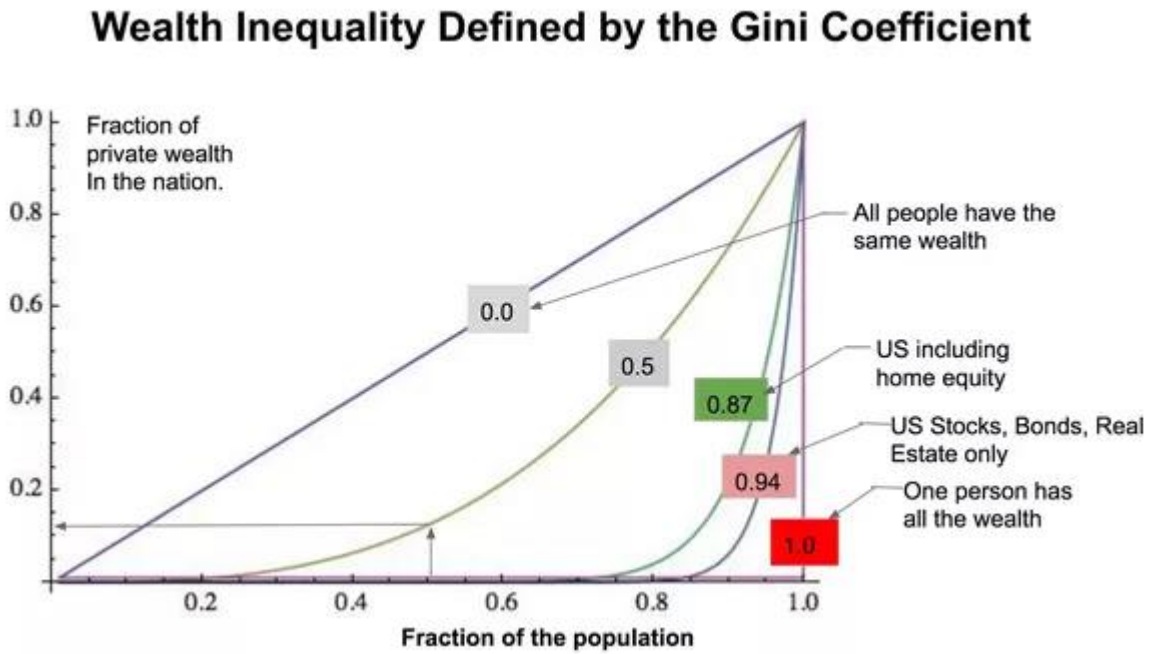
EQUITY BENCHMARKS

FOUR FAMILIES OF BENCHMARKS

1. Measures of Evenness
2. Measures of Vertical Equity
3. Accounting for Transport Poor
4. Equity between Transport Modes

EVENNESS

Variable	Gini
Transit Accessibility (spatial)	0.53
Transit Accessibility (individual)	0.46
Trips per Day	0.41
Activities per Day	0.44
Discretionary Activities per Day	0.70



VERTICAL EQUITY

Variable	High-Income / Low-Income	Middle-Aged / Youth	Middle-Aged / Elderly	Car / No Car
Transit Accessibility	0.78	1.23	1.02	0.49
Trips per Day	1.42	1.01	1.41	1.31
Activities per Day	1.44	1.05	1.38	1.31
Disc. Activities per Day	1.24	2.09	0.76	1.38

High Income = $125k and up
Low Income = $40k and under
Youth = 18 and under
Middle-aged = 19 to 64
Elderly = 65 and up

ACCOUNTING FOR THE TRANSPORT POOR - DECILES

Transit Accessibility Deciles	Overall Population	Car-Free Households	Persons 18 & under	Persons 65 & older	Persons in Low-Income Households	Persons in households not responding to income
1 (low)	575	6	79	79	23	44
2	575	11	71	91	35	44
3	576	17	73	93	40	45
4	574	19	76	77	36	39
5	576	13	69	91	36	41
6	575	24	63	98	51	41
7	575	40	59	105	61	47
8	575	47	58	102	61	44
9	575	82	54	89	68	44
10 (high)	574	142	32	80	66	45
Total	5,748	401	635	906	478	433

ACCOUNTING FOR THE TRANSPORT POOR – 100K GROUPS

Transit Accessibility Equal Intervals	Overall Population	Car-Free Households	Persons 18 & under	Persons 65 & older	Persons in Low-Income Households	Persons in households not responding to income
0 to 100k	2,411	55	312	356	140	179
100k to 200k	1,017	35	117	169	80	73
200k to 300k	973	70	100	177	103	77
300k to 400k	775	100	74	124	90	59
400k to 500k	416	89	27	59	47	32
500k to 600k	147	50	4	19	18	12
600k to 700k	12	3	1	2	1	1
Total	5,748	401	635	906	478	433

MODAL EQUITY – RATIOS OF TRANSIT TO AUTO ACCESS

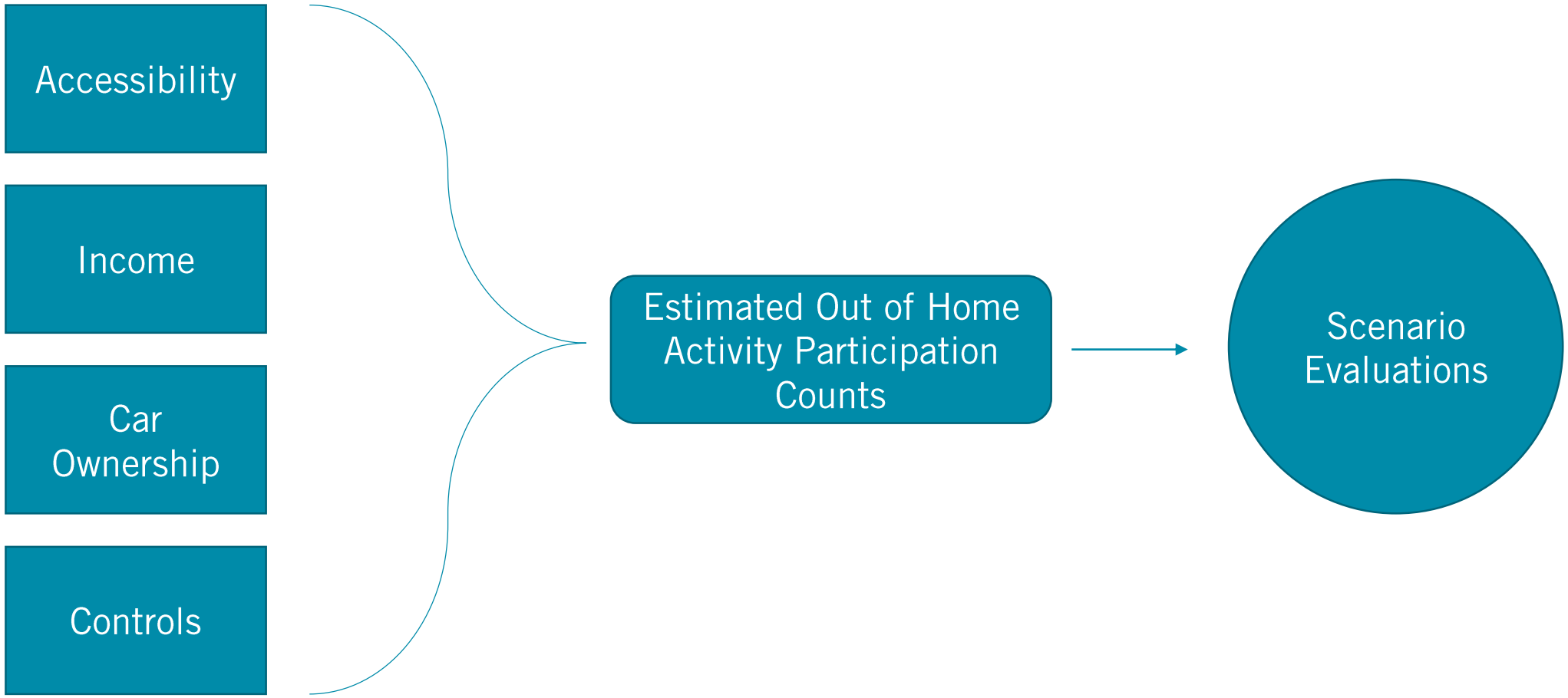
	Neighbourhood	Household	Individual
Mean	0.23	0.24	0.22
Standard deviation	0.11	0.13	0.13
minimum	0.00	0.00	0.00
10th percentile	0.09	0.07	0.07
20th percentile	0.13	0.11	0.11
30th percentile	0.16	0.15	0.14
40th percentile	0.18	0.19	0.17
50th percentile (median)	0.22	0.23	0.21
60th percentile	0.25	0.27	0.25
70th percentile	0.29	0.31	0.29
80th percentile	0.33	0.35	0.33
90th percentile	0.38	0.43	0.39
maximum	0.60	0.60	0.60

BENCHMARKS SUMMARY

- The benchmarks generated for this study are easily reproducible with each iteration of the TTS, and/or with major changes to the transport system
- Vertical Equity and Transport Poverty accounting lend them selves to normative interpretations.
- Gini coefficients don't say as much about how the unevenness manifests socioeconomically.
- Benchmarks all point to high levels of inequality in the current transportation system, although low income households have higher transit accessibility than others.

ACTIVITY GENERATION MODELS

GENERAL FRAMEWORK



MODEL SPECIFICATIONS

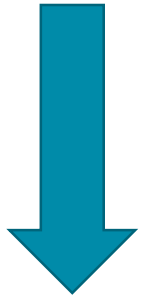
- Negative Binomial selected due to over-dispersion in the count data
- AICs and ρ^2's used as measures of goodness of fit
- Fit global models for main effects, but explore the income/car ownership/accessibility nexus using stratified subsampling approach
- Income entered categorically
- Car-ownership entered categorically based on ranges of cars per adult
- Other controls include: gender, household size, household type, children, age, employment status, student status, dwelling type, activity density, network density

SPECIFYING THE ACCESSIBILITY EFFECT

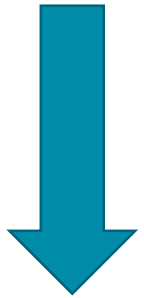
- Negative Binomial is a logged regression, assuming a homogenous exponential effect across all levels of an independent variable, like accessibility.
- But the effect of accessibility is likely heterogeneous since for ΔA change, the effect is likely small for both low and high values of A.
- We explore non-linear effects such as these in 3 ways:
  1. Linear: A is entered without transformations
  2. Quadratic: A and A^2 are both entered into the model without transformations
  3. Sigmoidal: A is transformed using a logistic function
- For the sigmoidal case, we estimate the best-fitting transforming accounting for maximal slope and midpoint of the function using a brute force parameter sweep

BASE MODEL RESULTS (INCIDENCE RATE RATIOS)

	Linear	Quadratic	Sigmoidal
Accessibility	1.0018	0.9984	
Accessibility2		1.0001	
f(Accessibility)			1.1640
hhld income (ref < 40k per year)			
40k-60k per year	1.0529	1.0514	1.0514
60k-100k per year	1.1000	1.0968	1.0969
100k-125k per year	1.1594	1.1545	1.1547
125k+ per year	1.1999	1.1931	1.1935
vehicles per hhld (ref = 0)			
0 < vehicles per adult < 0.5	1.1405	1.1503	1.1496
0.5 vehicles per adult	1.2054	1.2152	1.2140
0.5 < vehicles per adult < 1	1.2226	1.2321	1.2308
1 or more vehicles per adult	1.3057	1.3128	1.3123

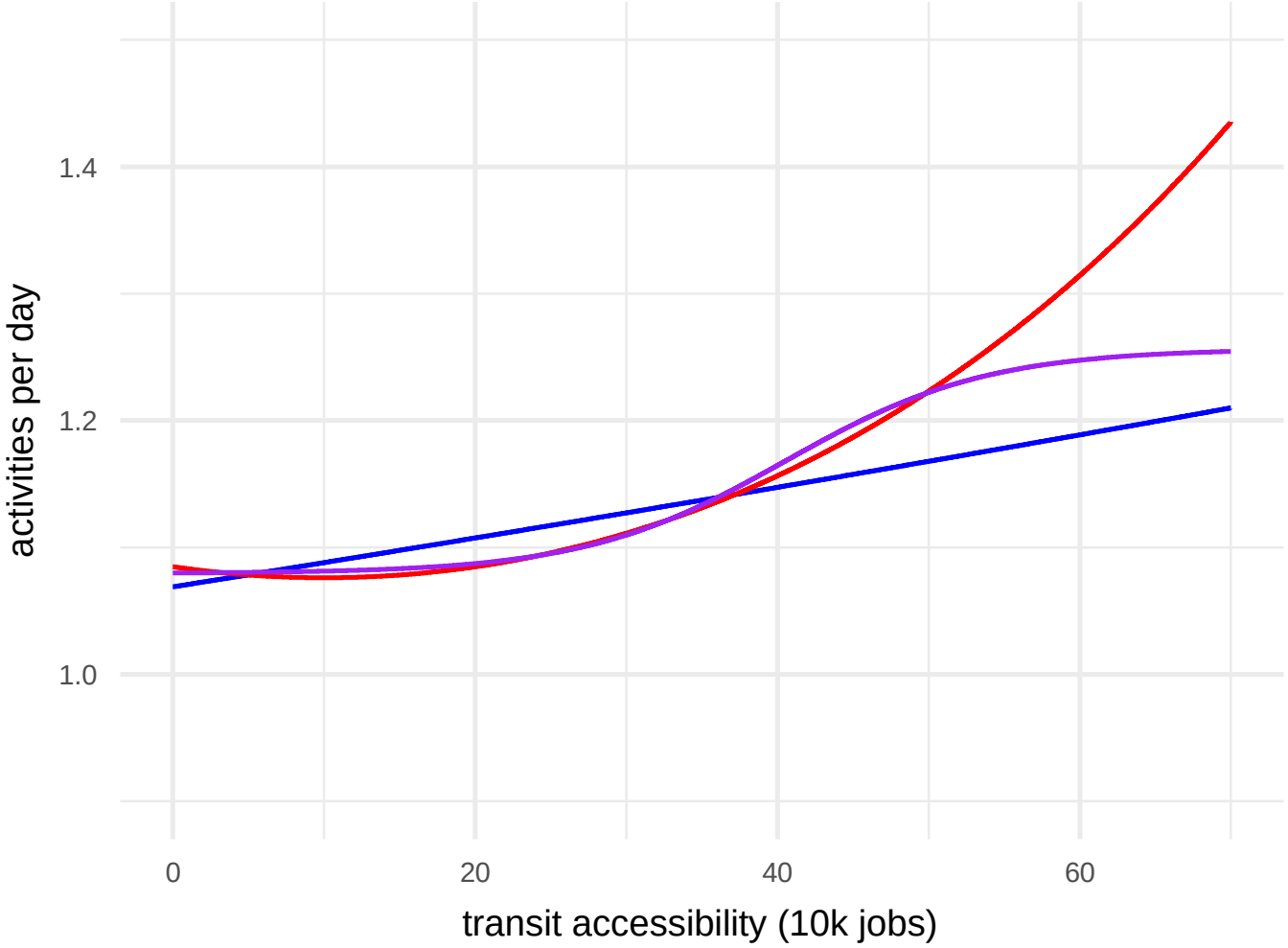


More participation with increasing income



More participation with increasing car ownership

ACCESSIBILITY AND ACTIVITIES PER DAY



- Blue – Linear
- Red – Quadratic
- Purple – Sigmoidal
- Assuming all other categorical variables at their reference levels and continuous variables at 0.
- Quadratic has slightly best fit

STRATIFIED SUBSAMPLES – COEFFICIENTS AND FIT

Strata Characteristics				Linear			Quadratic					Sigmoidal				
hhld Income	**Vehicles per Adult (VA)**	**N**	**n**	**acc_coef**	**acc_p**	**rho**	**acc_coef**	**acc_p**	**acc_2_coef**	**acc_2_p**	**rho**	**acc_L**	**acc_k**	**acc_xo**	**acc_p**	**rho**
< $40k	VA = 0	264475.29	9934	0.00388198	1.01E-05	0.13571905	-0.0040865	0.14883445	0.00015764	0.00310276	0.13640117	0.24425205	-0.175	40	1.00E-07	0.13639816
< $40k	0 < VA < 0.5	109122.46	3688	0.00101883	0.53096085	0.11568808	-0.0119657	0.00558767	0.00029571	0.00115594	0.1176328	1.72087871	-0.25	60	1.29E-07	0.12027237
< $40k	VA = 0.5	217566.73	10320	-0.0016231	0.10653466	0.08122173	-0.0047508	0.09204998	7.66E-05	0.23516289	0.08134611	-6.4926545	-0.001	25	0.10654069	0.08122172
< $40k	0.5 < VA < 1	52501.85	2081	-0.0017789	0.48238183	0.14338846	-0.0119781	0.0795378	0.00027713	0.10718035	0.14449907	-1.2683523	-0.25	60	0.41855709	0.14345207
< $40k	VA >= 1	189581.63	9888	-0.0001876	0.84485136	0.04346987	-0.0057145	0.02237413	0.00014449	0.01666025	0.04406437	0.10917102	-0.25	40	0.11476194	0.04372421
$40k - $60k	VA = 0	85983.26	3492	0.00635985	5.23E-05	0.1667247	0.00559705	0.26001093	1.37E-05	0.87148239	0.16673258	0.33051179	-0.1	30	3.92E-05	0.16688262
$40k - $60k	0 < VA < 0.5	115997.57	3997	-0.0033946	0.02073098	0.17521198	-0.0123175	0.00702789	0.00020763	0.03919721	0.17602291	-13.578756	-0.001	25	0.02073239	0.17521196
$40k - $60k	VA = 0.5	200720.77	9704	-0.0013482	0.16944292	0.07326639	-0.0012131	0.65785789	-3.33E-06	0.95787461	0.07326668	-0.1587279	-0.25	45	0.09764753	0.07335931
$40k - $60k	0.5 < VA < 1	93394.94	3768	0.00095034	0.61831433	0.08719114	0.00352256	0.46722801	-7.69E-05	0.56388126	0.08727181	3.41014832	-0.25	60	0.20247196	0.08748706
$40k - $60k	VA >= 1	213946.18	10928	0.00016613	0.84944127	0.05087896	-0.0005005	0.82737234	1.77E-05	0.75330601	0.05088957	0.11742114	-0.25	55	0.62042085	0.05090127
$60k - $100k	VA = 0	92831.18	3868	0.00648565	2.37E-05	0.15852411	0.00927255	0.08347622	-4.34E-05	0.58670373	0.15861722	0.28534583	-0.175	30	2.01E-06	0.16008893
$60k - $100k	0 < VA < 0.5	148082.71	5547	-0.0004764	0.69275587	0.182564	0.00182291	0.59182092	-5.44E-05	0.46950047	0.182644	-0.125069	-0.25	40	0.11565353	0.1829213
$60k - $100k	VA = 0.5	289143.76	13546	0.00023172	0.76295743	0.09108783	-0.0078485	0.00017202	0.00018931	3.11E-05	0.09235642	0.196216	-0.25	45	0.00124593	0.09183787
$60k - $100k	0.5 < VA < 1	182765.86	7383	-0.0003255	0.79449829	0.11230841	-0.0043519	0.17550979	0.00011313	0.1732553	0.11254634	0.57818932	-0.25	50	0.03987114	0.11282704
$60k - $100k	VA >= 1	428974.35	21237	0.00063411	0.30497347	0.04158651	-0.0017145	0.2552677	6.19E-05	0.08712752	0.04174361	0.31358151	-0.1	60	0.05127399	0.04173262
$100k - $125k	VA = 0	27407.26	1338	0.00998303	0.00214781	0.12654864	0.02523437	0.04045497	-0.000219	0.19616578	0.12830278	0.59014618	-0.1	25	0.00164822	0.12732023
$100k - $125k	0 < VA < 0.5	58578.55	2244	0.00335484	0.03993147	0.17274604	0.00471341	0.35603041	-3.02E-05	0.77895304	0.17277391	0.54740857	-0.025	25	0.03969184	0.17274969
$100k - $125k	VA = 0.5	125435.02	6344	-0.0010403	0.30140696	0.08844424	-0.002926	0.31346987	4.35E-05	0.48852893	0.08852676	-0.1699927	-0.025	25	0.30035079	0.08844505
$100k - $125k	0.5 < VA < 1	116076.35	4546	0.00137152	0.31599105	0.12282514	0.00394331	0.29038694	-7.00E-05	0.4588888	0.12293416	-1.1612105	-0.25	55	0.19515729	0.1229785
$100k - $125k	VA >= 1	267324.22	13033	0.00179526	0.02145334	0.04647547	0.00127692	0.51291488	1.39E-05	0.77192108	0.04648303	0.19287286	-0.05	40	0.02036574	0.04648314
$125k +	VA = 0	27034.08	1500	0.00718138	0.03468654	0.12017962	0.05034459	0.00016558	-0.0005991	0.00057793	0.13472583	0.6771082	-0.25	25	0.00027118	0.13207488
$125k +	0 < VA < 0.5	62543.58	2568	0.00206901	0.1815913	0.16508885	0.00217705	0.63667798	-2.35E-06	0.98014521	0.16508907	0.52201211	-0.25	55	0.0189226	0.1663127
$125k +	VA = 0.5	195656.52	10519	0.00220637	0.00552026	0.09204298	0.00290346	0.21314266	-1.48E-05	0.75050083	0.09205445	0.07994032	-0.25	25	0.00338586	0.09214329
$125k +	0.5 < VA < 1	211943.59	8507	0.00304283	0.00065428	0.09807488	-0.0013883	0.58895892	0.00011745	0.06542353	0.09841835	0.17837626	-0.25	30	2.64E-06	0.09910709
$125k +	VA >= 1	584353.88	29240	0.00368136	4.66E-16	0.04974955	0.00292232	0.02072199	1.97E-05	0.51968405	0.04976619	0.13552462	-0.25	25	1.68E-16	0.04981684
decline	VA = 0	97644.83	4405	0.00351676	2.91E-02	0.16904014	0.00349737	0.48519891	3.74E-07	0.99673967	0.16904014	0.16170325	-0.25	35	0.00803069	0.16952936
decline	0 < VA < 0.5	115399.31	4320	0.00154334	0.2769972	0.10709158	0.00773535	0.07583398	-1.44E-04	0.13282913	0.1075263	-2.1527062	-0.25	60	0.05199725	0.10763037
decline	VA = 0.5	209902.09	11298	0.00043614	0.63110518	0.06097584	0.00062807	8.16E-01	-4.648E-06	9.40E-01	0.06097638	0.01862094	-0.25	25	0.54047227	0.06098945
decline	0.5 < VA < 1	174769.73	7167	2.39E-03	0.04390363	0.0772823	0.00152672	0.6495835	2.43E-05	0.78443671	0.07729166	0.17728437	-0.25	35	0.01336819	0.07752762
decline	VA >= 1	386261.59	21043	0.00229688	0.0003402	0.03509542	0.00174897	3.12E-01	1.465E-05	7.33E-01	0.03510173	0.47754831	-0.025	60	0.00031796	0.0351015

BASE MODEL SUMMARY

- Accessibility, income and car ownership are shown to have a positive effect on activity generation
- Effects of accessibility are larger and significant among carless households and households with 0.5 or fewer cars per adult
- Accessibility tends to be significant for wealthy households, even if they have cars, but not so for poor households with cars.
- Several sub-models need to be revisited, e.g. carless/high-income has a negative accessibility curve as best fitting model

SCENARIO EFFECT SIZES

EFFECT SIZES

- With stratified models we can forecast how different types of households are likely to respond to accessibility improvements conditional on:
  - Income level
  - Automobile ownership
  - Baseline accessibility level

- We test 5 transit improvement scenarios that are applied uniformly over space. The scenarios are not tied to any specific transit plan, but their levels are informed by past research

- Proportional jobs accessibility increases of 10% and 25%
- Absolute accessibility increases of 50,000, 100,000 and 200,000 jobs

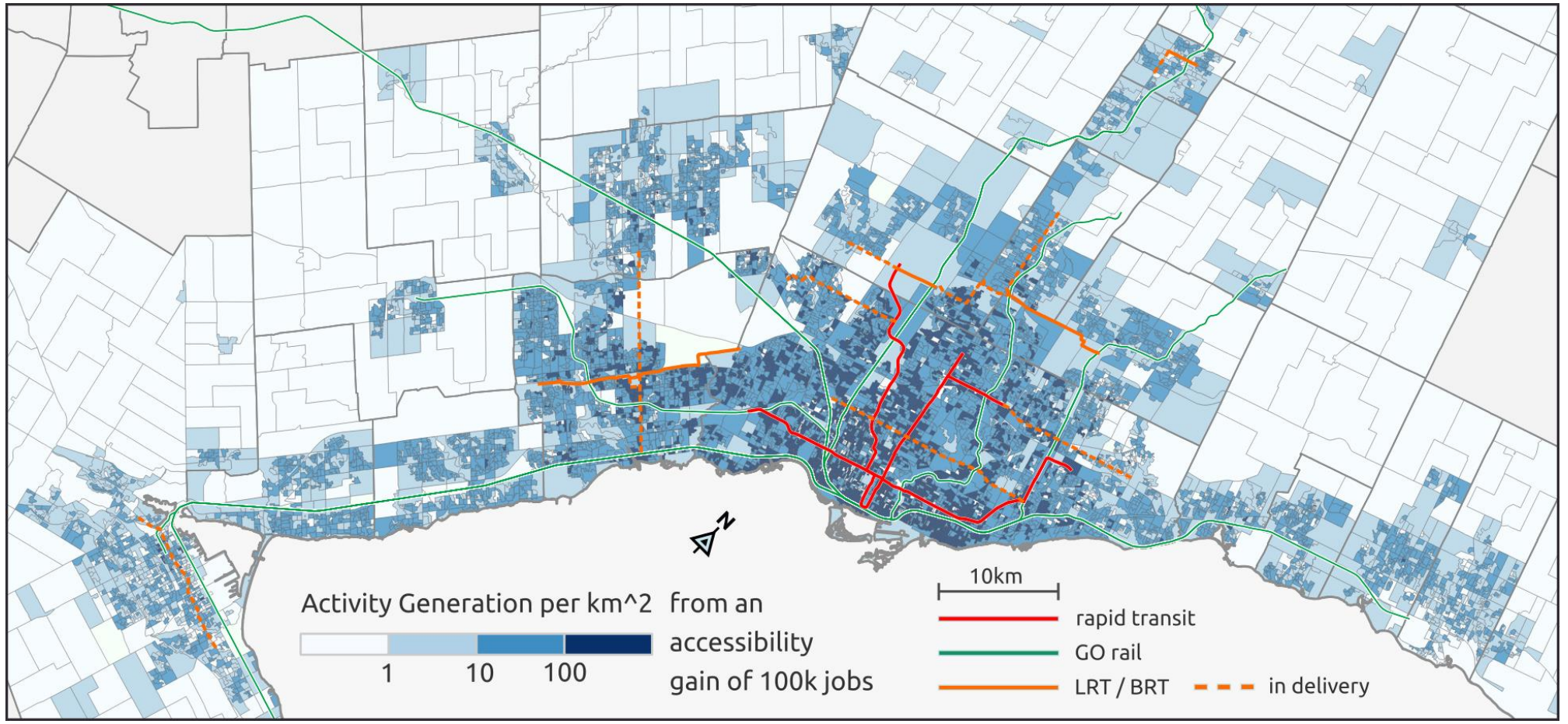
PROJECTED ACTIVITIES GENERATED BY TRANSIT IMPROVEMENT

hhld Income	Vehicles per Adult (VA)	n	N	observed total daily activities	Increase in Activities for each scenario				
					10 percent	25 percent	50k jobs	100k jobs	200k jobs
< $40k	VA = 0	9,934	264,475	217,867	3,859	9,141	5,494	11,319	21,949
< $40k	0 < VA < 0.5	3,688	109,122	92,225	1,784	6,914	1,752	5,327	24,702
< $40k	VA = 0.5	10,320	217,567	216,610	0	0	0	0	0
< $40k	0.5 < VA < 1	2,081	52,502	47,554	0	0	0	0	0
< $40k	VA >= 1	9,888	189,582	240,964	0	0	0	0	0
$40k - $60k	VA = 0	3,492	85,983	94,397	1,753	3,916	2,623	4,970	8,645
$60k - $100k	VA = 0	3,868	92,831	112,578	2,466	4,996	3,361	5,960	9,199
$100k - $125k	VA = 0	1,338	27,407	34,533	797	1,661	1,049	1,864	2,921
$125k +	VA = 0	1,500	27,034	37,000	342	596	489	727	1,013
decline	VA = 0	4,405	97,645	70,984	399	825	755	1,344	2,329
all others	all others	196,939	4,181,271	5,295,963	14,656	36,377	28,383	64,884	175,911
Total		247,453	5,345,419	6,460,674	26,056	64,426	43,906	96,394	246,669

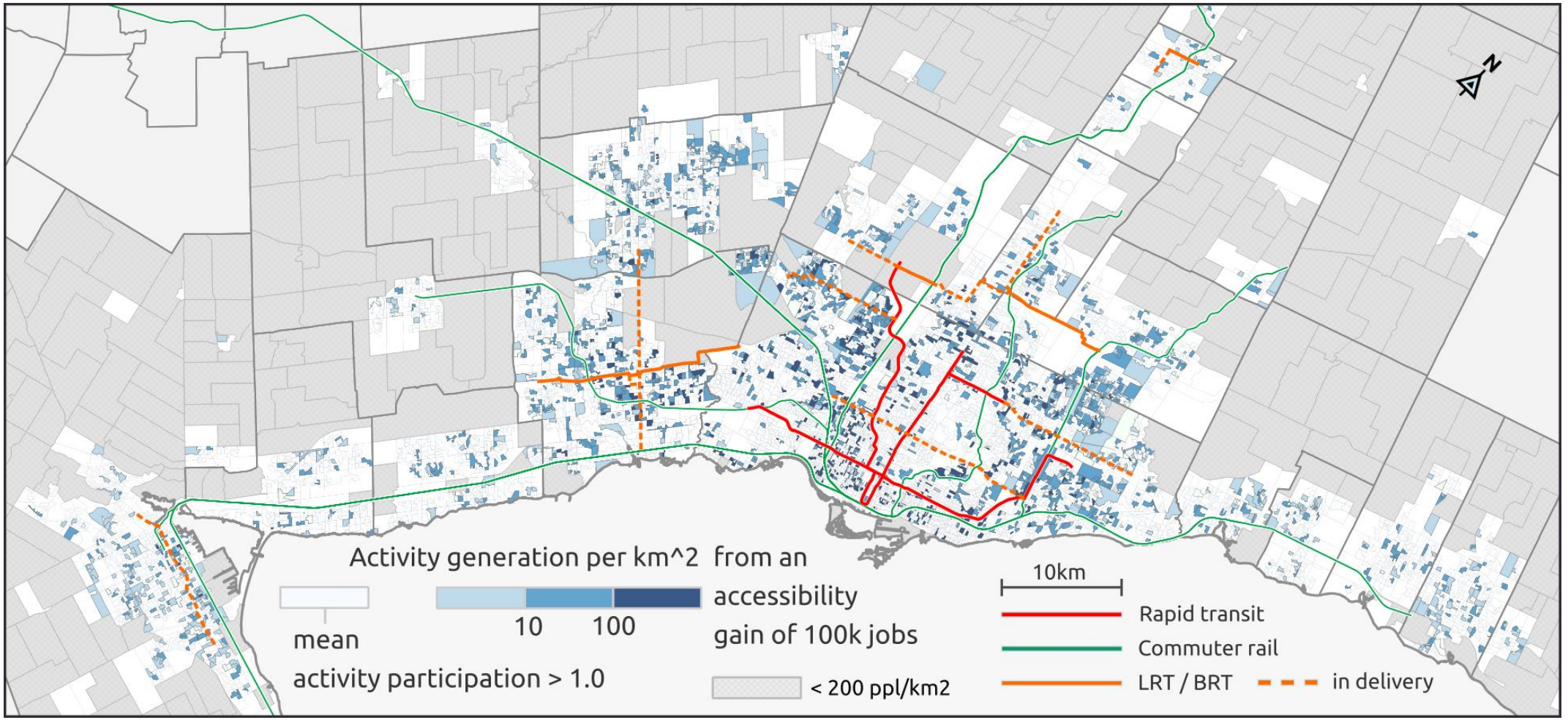
SHARE OF ACTIVITY GAINS BY STRATA

hhld Income	Vehicles per Adult (VA)	n	N	observed total daily activities	Percent of overall activity gain for each scenario				
					10 percent	25 percent	50k jobs	100k jobs	200k jobs
< $40k	VA = 0	4.01%	4.95%	3.37%	14.81%	14.19%	12.51%	11.74%	8.90%
< $40k	0 < VA < 0.5	1.49%	2.04%	1.43%	6.85%	10.73%	3.99%	5.53%	10.01%
< $40k	VA = 0.5	4.17%	4.07%	3.35%	0.00%	0.00%	0.00%	0.00%	0.00%
< $40k	0.5 < VA < 1	0.84%	0.98%	0.74%	0.00%	0.00%	0.00%	0.00%	0.00%
< $40k	VA >= 1	4.00%	3.55%	3.73%	0.00%	0.00%	0.00%	0.00%	0.00%
$40k - $60k	VA = 0	1.41%	1.61%	1.46%	6.73%	6.08%	5.97%	5.16%	3.50%
$60k - $100k	VA = 0	1.56%	1.74%	1.74%	9.46%	7.75%	7.65%	6.18%	3.73%
$100k - $125k	VA = 0	0.54%	0.51%	0.53%	3.06%	2.58%	2.39%	1.93%	1.18%
$125k +	VA = 0	0.61%	0.51%	0.57%	1.31%	0.93%	1.11%	0.75%	0.41%
decline	VA = 0	1.78%	1.83%	1.10%	1.53%	1.28%	1.72%	1.39%	0.94%
all others	all others	79.59%	78.22%	81.97%	56.25%	56.46%	64.65%	67.31%	71.31%
Total		100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%

ACTIVITY GENERATION OVER SPACE



ACTIVITY GENERATION INSIDE PARTICIPATION DESERTS



ACTIVITY TYPE DISTRIBUTIONS FOR K ACTIVITIES

Number of Activities	Work	School	Shopping	Facilitating Passenger	Other
0	0.00	0.00	0.00	0.00	0.00
1	0.66	0.08	0.10	0.04	0.13
2	0.62	0.07	0.36	0.33	0.62
3	0.70	0.05	0.65	0.63	0.96
4	0.80	0.03	1.00	0.96	1.20
5	0.80	0.02	1.43	1.45	1.30

ACTIVITY GENERATIONS BY ACTIVITY TYPE

	10 percent	25 percent	50k jobs	100k jobs	200k jobs
Work	8,770	22,000	14,770	32,660	84,191
School	930	2,360	1,570	3,480	9,000
Shopping	4,810	11,780	8,110	17,730	45,170
Facilitating	4,300	10,480	7,250	15,810	40,190
Other	7,250	17,810	12,210	26,720	68,120
All	**26,050**	**64,430**	**43,910**	**96,390**	**246,670**

MONETIZATION OF GENERATED ACTIVITIES

- We have individual and aggregated estimates of new daily activities for different activity types
- How much is each new activity worth?
- Not able to back this out from a model econometrically because of categorical income variables and no other costs in the model
- We can look a bit more for existing valuations of trip types in the literature, but nothing was found in our initial scan

CONCLUSIONS

MAIN CONTRIBUTIONS

- Characterization of the current levels of inequality in the GTHA transportation system
- Performed an accounting of transport poverty
- Computed a set of benchmarks that can be tracked over time
- Found significant relationships between accessibility and activity participation, especially for carless households
- Carless households tend to be poor households, and so increases in transit accessibility result in gains in a low-income activity generation

CAVEATS

- TTS may be underreporting discretionary activities, trips made by youth, and short trips or activities. Not sure if underreporting is related to income/access/car ownership.

- We are limited to a weekday analysis and have no means to estimate effects for weekends.

- We are using a single accessibility measure (jobs) to model activity generation in general. It might be better to predict separate models for different activity types, using different accessibility scores.

- TTS is limited in terms of attitudes and preferences

FUTURE RESEARCH

- More efforts are needed to estimate value of each new trip generation, perhaps from the literature?
- Cross-sectional analysis using TTS casts a shadow of doubt over causality/directionality. It may be preferable to research this longitudinally, either empirically or within a simulation framework.
- We observe many low-income drivers in the region. Understanding their mode choice elasticity to transit accessibility could help drive transit ridership while lowering mobility costs among low-income households

QUESTIONS?