# DETERMINANTS OF MODE SHARE OVER TIME

## *How a changing transport system affects transit use in Toronto, Canada*

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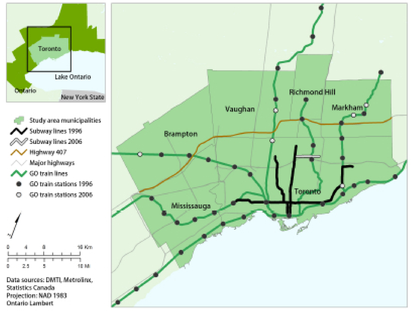
## ABSTRACT

We explore differences in transit mode share by job categories in Toronto, Canada in 1996 and 2006. We find that assessing commuting patterns by job category tells a more nuanced story about transit mode share compared to analyzing all jobs together.

Using linear regression analysis, we test accessibility to jobs, transport infrastructure, and social disadvantage variables. We find that some variables affect all job categories similarly, such as local bus frequency, highway construction, and social disadvantage. Others job categories show notable differences in how variables affect workers' propensity to take transit or not, such as accessibility to jobs and subway construction. Results from this study show that job types may differ in their response to the same variables.

## CONTEXT

The study area is the City of Toronto and its adjacent municipalities that have significant public transit connections to the City of Toronto. From 1996 to 2006, the region experienced the suburbanization of both jobs and socially disadvantaged residential areas.




Several changes occurred in this period including the construction of Hwy 407 (a tolled expressway) opening of a subway extension, and new commuter rail stations.

## METHODOLOGY

We use four multiple linear regression models. For each model the dependent variable is the percentage of transit share by Traffic Analysis Zone (TAZ) for each job category.

The job categories tested are:
1. ***All jobs*** (agglomerated job categories),
2. ***Office*** (includes office and professional),
3. ***Retail*** (includes retail, sales, and service), and
4. ***Trades*** (includes manufacturing, construction, and transport).

Regression results summarized on the poster are statistically significant at the 95% and 99% confidence interval. All results are discussed in the paper.

The explanatory variables fall into three categories, plus a year dummy to capture the general changes in transit mode share between 1996 and 2006. Interaction variables were used to isolate variables' affect in different years.

### *Job accessibility*

To measure job accessibility, we use the gravity model which takes into account the diminishing attractiveness of potential activity locations further away. In-vehicle transit time is used.

### *Social disadvantage*

We use a composite social disadvantage indicator to test for the 10% most socially disadvantaged TAZs. It is a standardized sum income, unemployment, recent immigrant status, and unaffordable rents.

### *Transport networks*

This group of variables includes proximity to subway stations, GO Train stations, and the new Highway 407, as well as morning peak local bus frequency (at the TAZ level).

## ANALYSIS

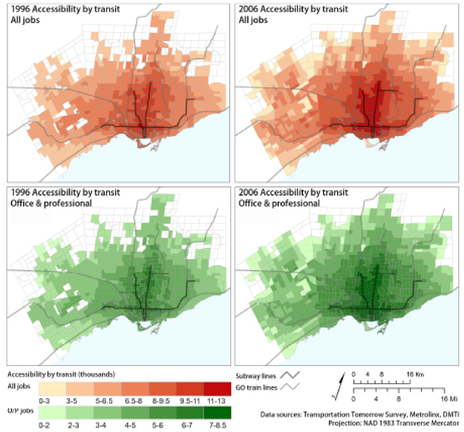



Figure 1: Job accessibility by transit to all jobs and office jobs in 1996 and 2006.

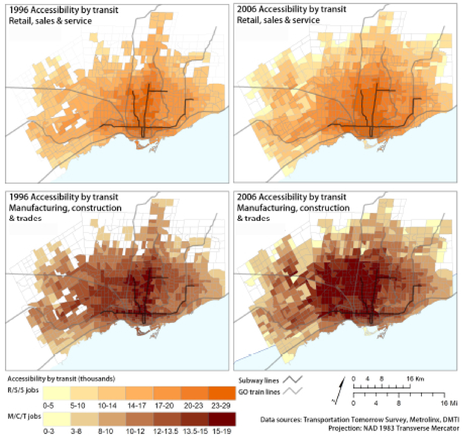



Figure 2: Job accessibility by transit to retail jobs and trades jobs in 1996 and 2006.

### JOB ACCESSIBILITY CHANGES

Accessibility measures capture the number of jobs each job category can access via transit. Fig. 1 and 2 show that accessibility expands around the subway from 1996 to 2006. In contrast, trades job accessibility shifts from roughly surrounding the subway lines in 1996 towards the northwest, which is further away from downtown and the subway lines in 2006.

### REGRESSION RESULTS

#### *Job accessibility*

We find that an increase of 10% in accessibility to all jobs by transit is associated with a 2.0% increase in transit share. This is similar to the office jobs and retail jobs models (+2.1%). However, an increase in transit accessibility to trades jobs is expected to have far less of an effect on transit mode share (+0.1%) in comparison.

#### *Social disadvantage*

Our regression analyses show that the more socially disadvantaged a TAZ is, the more likely workers will commute by transit regardless of job type (ranging from +1.1% to +1.6% per each social disadvantage decile). Then, we tested the 10% most socially disadvantaged TAZs with job accessibility (interaction variable). We find that a 10% improvement in job accessibility by transit is likely to correspond to a 3.2% increase in transit mode share for trades jobs, and 0.03% for the all jobs model.

#### *Transport networks*

Living within 1 kilometer of a subway station shows all job categories are more likely to take transit to work. In other words, proximity to a subway station has the most influence on transit mode share as it shows the largest coefficient in all 4 models: all jobs (+7.7%), office jobs (+6.1%), retail jobs (+5.9%) and trades jobs (+11.3%).
However, the new subway stations in 2006 (shown in Fig. 1 and 2) do *not* serve trades workers commuting to skills-matched jobs (-6.7%) and is insignificant for the other models. Fig. 2 illustrates the concentrations of trades jobs are not well-served by the new subway.

Construction of Highway 407 clearly has a negative effect across all jobs and the different job category models. Commuters residing in TAZs within 1 kilometer of the new Highway 407 are *less* likely to commute by transit compared to other TAZs in the region: all jobs (-3.6%), office jobs (-4.1%), retail jobs (-4.7%), and trades jobs (-3.8%).

Adding buses also helps boost transit share. We find that an addition of 100 buses passing through a TAZ corresponds to increases in transit use for all jobs (+2.0%), office jobs (+2.7%), and retail jobs (+2.1%), but not for trades jobs (insignificant).

## CONCLUSIONS

We find that increases in job accessibility by transit benefits most jobs, and social disadvantage positively corresponds with transit mode share to a similar magnitude in all models. Transport infrastructure and networks are important determinants of transit mode share as proximity to subway stations has the largest coefficient in all 4 models.

Yet, we find transit infrastructure must serve employment destinations in order to influence ridership, as the new subway did not significantly or positively influence transit mode share in 2006. Finally, we confirm that buses increase transit mode share, while proximity to a new highway decreases it.

## ACKNOWLEDGEMENTS

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