How Frequent is Frequent Enough? Exploring the Relationship between the Approach Taken to Identify Ride-sourcing Users and the Specification of Ride-sourcing Adoption Models

Civil & Mineral Engineering
UNIVERSITY OF TORONTO

Maria Vetrici maria.vetrici@mail.utoronto.ca
Patrick Loa ploa@ucdavis.edu
Felita Ong felita.ong@mail.utoronto.ca
Prof. Khandker Nurul Habib khandker.nurulhabib@utoronto.ca

Paper # TRBAM-24-00713
TDMG TRAVEL DEMAND MODELLING GROUP

INTRODUCTION

The growth in the popularity of ride-sourcing services (such as those offered by Uber, Lyft, and DiDi) has prompted numerous investigations into the use of these services.

- A fundamental component of these studies is the identification of survey respondents as either *users* or *non-users*
- Respondents have been identified as users based on:
  - Whether they have *ever* used ride-sourcing
  - Whether they have used ride-sourcing *during a specific period*
  - *How often* they use ride-sourcing
- Despite the number of studies on ride-sourcing adoption and use, the impacts of the approach taken to identify users has not been explored.

Key research questions:

- Does the approach taken to identify users affect the final specification of models of ride-sourcing adoption?
- Does the approach taken to identify users affect the impact of a given factor on the probability of a person being a user?

STUDY AREA and DATA DESCRIPTION

The study used data from two web-based surveys that were administered to a random sample of market research panel members who live in *Toronto* and *Metro Vancouver*.

- Metro Vancouver:
  - Survey on the Effects of Ride-sourcing in the Vancouver Region (*SERVR*)
  - Ride-sourcing was introduced in 2020
- Toronto:
  - Survey to Predict the Repercussions of the Introduction of Novel Transportation network services (*SPRINT*)
  - Ride-sourcing was introduced in 2014
- The surveys collected information on:
  - Personal and household attributes
  - Use of ride-sourcing services
  - Attitudes and perceptions
  - Choices in stated preference experiments

Table 1: Survey period and sample size of the surveys

Survey	Survey Period	Sample Size
SPRINT	May 2019	822
SERVR	March – May 2022	1,851

METHODOLOGY

Ride-sourcing adoption among SPRINT and SERVR respondents was modelled using binary logistic regression:

- The logged odds of person i being a ride-sourcing user is:

$$L_i = \ln\left(\frac{P_i}{1-P_i}\right) = \beta_0 + \boldsymbol{\beta}' \boldsymbol{x_i}$$

Where:

P_i is the probability of person i being a ride-sourcing user

β_0 is the intercept

$\boldsymbol{\beta}$ is a vector of parameters

$\boldsymbol{x_i}$ is a vector of explanatory variables

Three models were estimated using each dataset, each with a different approach for classifying respondents as ride-sourcing users:

- **Model 1:** respondents who have *ever* used ride-sourcing are classified as users
- **Model 2:** respondents who use ride-sourcing *at least once per year* are classified as users
- **Model 3:** respondents who use ride-sourcing *at least once per month* are classified as users

Model 1 was treated as a benchmark because the approach for classifying respondents was broadest among the three models. For each dataset, the models were compared based on:

- Their final specification
- The 95% confidence interval of the parameter estimates

COMPARISON OF RIDE-SOURCING USE

Ride-sourcing frequency is relatively consistent among the two sets of respondents. Among users, *at least once per month* was the most common response.

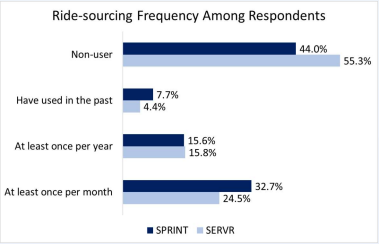

Figure 1: Comparison of ride-sourcing frequency

FINAL MODEL SPECIFICATIONS

Table 2: Final specification of SERVR models

Variable	Model 1: Has ever used ride-sourcing				Model 2: Makes >1 trip/year			Model 3: Makes >1 trip/month		
	Coeff.	OR	t-stat	95% CI (coeff.)	Coeff.	OR	t-stat	Coeff.	OR	t-stat
Age (yrs.)	-0.023	0.98	-4.87	[-0.023, -0.023]	-0.021	0.98	-4.33	-0.020	0.98	-3.43
Employed full-time [0/1]	0.295	1.34	2.09	[0.289, 0.302]	0.298	1.35	2.01	-	-	-
Employed (full- or part-time) [0/1]	-	-	-	-	-	-	-	0.349	1.42	1.21
Master's degree or higher [0/1]	0.275	1.32	1.64	[0.267, 0.282]	0.270	1.31	1.56	-	-	-
Has a driver's license [0/1]	0.792	2.21	1.97	[0.774, 0.810]	0.591	1.81	1.40	-	-	-
Has a transit pass [0/1]	0.289	1.33	2.04	[0.282, 0.295]	0.483	1.62	3.32	0.344	1.41	2.13
Has access to a bicycle (own or bikeshare) [0/1]	0.250	1.28	1.93	[0.244, 0.256]	0.355	1.43	2.60	0.239	1.27	1.47
Uses bike-sharing services at least once per year [0/1]	1.244	3.47	8.35	[1.238, 1.251]	1.410	4.09	9.44	0.869	2.39	4.87
Uses car-sharing services at least once per year [0/1]	-	-	-	-	-	-	-	-0.757	0.47	-1.60
High income (> $100k/year) [0/1]	0.378	1.46	2.83	[0.372, 0.384]	0.421	1.52	3.06	0.424	1.53	2.02
Middle income ($50-100k/year) [0/1]	-	-	-	-	-	-	-	0.366	1.44	1.79
Household size	-0.079	0.92	-1.52	[-0.082, -0.077]	-	-	-	-0.084	0.92	-1.44
Agrees ride-sourcing services would be a reliable way to travel [0/1]	0.718	2.05	4.62	[0.711, 0.725]	0.802	2.23	4.99	0.585	1.79	3.14
Agrees ride-sourcing services would be a convenient way to travel [0/1]	0.476	1.61	3.04	[0.469, 0.483]	0.700	2.01	4.29	0.754	2.12	4.00
Prefers own car when making a trip [0/1]	-0.405	0.67	-2.78	[-0.412, -0.398]	-0.227	0.80	-1.48	-0.573	0.56	-3.54
Agrees new experiences are important [0/1]	0.283	1.33	2.01	[0.277, 0.290]	0.239	1.27	1.46	-	-	-
Enjoys trying new products and technologies [0/1]	-	-	-	-	0.276	1.32	1.81	0.323	1.38	1.89
Concerned about safety when considering ride-sourcing services [0/1]	-	-	-	-	-0.645	0.52	-4.59	-	-	-
Uses the internet or their smartphone to check when bus/train will arrive (at least once per month) [0/1]	0.587	1.80	3.69	[0.580, 0.595]	0.586	1.80	3.41	0.605	1.83	2.50
Uses the internet or their smartphone to choose means of transportation (at least once per month) [0/1]	0.256	1.29	1.78	[0.249, 0.263]	0.396	1.49	2.63	0.468	1.60	2.51
Uses the internet or their smartphone to choose a destination (at least once per month) [0/1]	-	-	-	-	-	-	-	-0.766	0.46	-2.74
Shops online (at least once per month) [0/1]	0.216	1.24	1.52	[0.210, 0.223]	-	-	-	0.581	1.79	3.05
Uses mobile payment technology (at least once per month) [0/1]	0.810	2.25	5.66	[0.803, 0.816]	0.853	2.35	5.87	1.442	4.23	7.30
Uses food delivery services (at least once per month) [0/1]	-	-	-	-	-	-	-	0.571	1.77	2.91
Goodness-of-fit measures										
AIC	1656.933				1531.351			1249.896		
McFadden's pseudo-R^2	0.363				0.401			0.413		
Nagelkerke's pseudo-R^2	0.526				0.564			0.549		
AUC	0.878				0.893			0.906		

Table 3: Final specification of SPRINT models

Variable	Model 1: Has ever used ride-sourcing				Model 2: Makes >1 trip/year			Model 3: Makes >1 trip/month		
	Coeff.	OR	t-stat	95% CI (coeff.)	Coeff.	OR	t-stat	Coeff.	OR	t-stat
Age (yrs.)	-0.066	0.94	-10.42	[-0.066, -0.065]	-0.067	0.94	-10.26	-0.060	0.94	-8.70
Full-time employed [0/1]	0.732	2.08	3.86	[0.719, 0.744]	0.704	2.02	3.41	0.538	1.71	2.48
Has a driver's license [0/1]	0.524	1.69	2.28	[0.509, 0.540]	0.580	1.79	2.35	0.649	1.91	2.68
Has a transit pass [0/1]	0.747	2.11	4.09	[0.734, 0.759]	0.699	2.01	3.88	0.967	2.63	5.46
High income (> $100k/year) [0/1]	0.457	1.58	2.22	[0.443, 0.471]	0.298	1.35	1.47	0.276	1.32	1.37
Household size	-0.128	0.88	-1.90	[-0.132, -0.123]	-0.218	0.80	-3.12	-0.197	0.82	-2.80
Lives in a house (single or semi-detached) [0/1]	-0.615	0.54	-3.37	[-0.628, -0.603]	-0.401	0.67	-2.22	-	-	-
Number of vehicles	0.408	1.50	3.36	[0.400, 0.417]	0.216	1.24	1.78	-	-	-
Lives with at least four students [0/1]	-1.655	0.19	-3.07	[-1.692, -1.618]	-1.243	0.29	-2.17	-1.456	0.23	-2.04
Lives with at least one part-time worker [0/1]	0.339	1.40	1.75	[0.326, 0.352]	0.482	1.62	2.46	0.478	1.61	2.33
Number of full-time workers in the household	-	-	-	-	0.157	1.17	1.49	0.164	1.18	1.59
Lives in Toronto-East York district [0/1]	0.415	1.52	2.33	[0.403, 0.428]	0.340	1.40	1.92	0.303	1.35	1.73
Places importance on the weather when considering public transit [0/1]	0.533	1.70	3.01	[0.521, 0.545]	0.732	2.08	4.21	0.833	2.30	4.58
Places importance on safety when considering public transit [0/1]	-0.286	0.75	-1.34	[-0.301, -0.272]	-	-	-	-	-	-
Places importance on reliability when considering public transit [0/1]	0.389	1.48	1.52	[0.371, 0.406]	-	-	-	-	-	-
Places importance on parking availability when considering public transit [0/1]	-	-	-	-	0.255	1.29	1.31	-	-	-
Intercept	1.37	3.93	3.04	[1.337, 1.398]	0.983	2.67	2.33	-0.104	0.90	-0.24
Goodness-of-fit measures										
AIC	908.595				912.086			860.695		
McFadden's pseudo-R^2	0.221				0.225			0.195		
Nagelkerke's pseudo-R^2	0.350				0.358			0.305		
AUC	0.803				0.806			0.792		

RESULTS

The final specification of the adoption models differed based on approach taken to identify ride-sourcing users.

- Explanatory variables that were statistically significant in Model 1 were not significant in Model 2 and/or Model 3
- Model 2 and Model 3 include explanatory variables that were not statistically significant in Model 1

The impacts of explanatory variables on the odds of a person being a ride-sourcing user differ based on the approach taken to identify ride-sourcing users.

- Most parameter values in Model 2 and Model 3 were outside of the 95% CI of the values in Model 1
- Notable exceptions were observed for education, full-time employment, and the use of smartphones to check transit schedules in the SERVR model

DISCUSSION and IMPLICATIONS

Despite the similarities in explanatory variables, the approach taken to identify users can influence the specification of models of ride-sourcing adoption. Moving forward, studies on the adoption of ride-sourcing (and other emerging mobility services) should:

- Be mindful of the impacts of the approach taken to identify users on the results of the subsequent analysis
- Consider omitting those who use ride-sourcing sporadically (less than 1 trip/year)
- Develop criteria to identify users that are not overly restrictive

Based on the results of this analysis, it is recommended that those who use ride-sourcing *at least once per year* be the criterion for identifying users.

CONCLUSIONS

- The approach taken to identify users can influence the specification of models of ride-sourcing adoption
- Criteria to identify ride-sourcing users should omit those who use these services sporadically
- Future studies on ride-sourcing adoption could develop separate models for frequent and infrequent users