Getting A Lift: Peer-To-Peer Ridesharing In Canada

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Introduction

When the Internet was launched commercially twenty five years ago, few people outside the scientific and academic communities were aware of this technology. It has since altered Canadian society in unimaginable ways; it is now possible to search, purchase and sell just about anything online. In the transportation sector, the initial impacts of digital technology included changes to scheduling and reservation systems, logistics and supply chains, and the introduction of mobile devices and tracking technologies.

Today, we can add peer-to-peer ride sharing services, or ridesharing, to the list. And to measure its impact, Statistics Canada recently asked Canadians the extent to which they used peer-to-peer ride sharing services. During a one year period, 7.0% of persons aged 18 and older used such services. On average over the same period, users of peer-to-peer or ridesharing services each spent $122. While this is less than half of what the average Canadian household spent on bus, subway or streetcar services ($271) in the same year, it already exceeds what was spent on taxis ($100) during 2016.[1]

This research paper further examines these survey findings on ridesharing. Following a review and examination of methods and data, it presents a binary logit model. We hypothesize that the use of ridesharing is related to those factors that influence Internet use in general, such as age, education, income and location. The paper concludes by pointing to some transportation planning considerations. Ridesharing appears to be both a complement and substitute for urban transit and also has the potential to fundamentally alter current planning axioms.

Review

Statistics Canada has been measuring the digital economy since 1999 with surveys of both consumers (Household Internet Use Survey) and businesses (Survey of Electronic Commerce and Technology). While these survey instruments focussed initially on the penetration rates of digital technologies, they have since evolved to measure the uses and impacts of the Internet on both individuals and businesses. Today, the sharing economy, activity facilitated by digital platforms where people offer their skills (e.g. driving) and their resources (e.g. properties) for money, is playing an increasingly important role in the Canadian economy.

While ridesharing per se has existed for some time, earlier versions were in essence traditional car-pooling resulting from lower private vehicle ownership rates in the 1950s and into the 1960s and then as a response to higher energy prices in the 1970s and into the 1980s. Today's concept of ridesharing is considered as an activity facilitated by digital platforms and Internet technology. The literature on ridesharing tends to be of two varieties. One is to study the traditional car-pooling option as a possible mode of transport by trip purpose.[2] The other type of study focuses on mobile-sourced ridesharing via platforms like Uber and impacts on other modes such as public transit[3] or on traffic congestion.[4]

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There are, given its recency, few studies to date that have attempted to identify the socioeconomic characteristics of those individuals who use peer-to-peer ride sharing services. One study focuses on a dynamic ride-sharing service in a university setting. It concludes that students are more willing to partake as ride-seekers in real-time ridesharing programs compared to university staff and employees, who were more interested in offering rides.[5]

With its potential to fundamentally alter transportation planning axioms, it is important to begin establishing benchmark measures such as penetration rates. Based on our initial look at data, we hypothesize that the socio-economic characteristics associated with the use of peer-to-peer ride sharing services are similar to those that determine Internet use in general.[6] That is, we expect the prevalence of peer-to-peer ride sharing to be positively related to higher levels of education and population (i.e. city size) and negatively related to age and being female.

Data and Methods

As part of Statistics Canada's October 2016 Labour Force Survey (LFS), respondents were asked seven additional questions on the sharing economy. These included questions on peer-to-peer ride sharing services that connect riders and drivers through a mobile application that acts as an intermediary and processes the payment from the rider to the driver. For these additional questions, the response rate was 88% and the LFS has a sample of approximately 100,000 individuals. In response to the first question - In the past 12 months, did you use ride services such as Uber, Lyft, etc.? - approximately 7.0% of Canadians aged 18 years and older used peer-to-peer ride sharing services from November 2015 to October 2016.[7] As expected, the prevalence of peer-to-peer ride sharing services varies by location and by socio-economic characteristics (Table 1).

Population Group

Previous research on Internet use attempted to discern the importance of urban size in the take up rate of digital technologies. It appeared that such technologies followed a hierarchical diffusion pattern starting with early adopters in larger centres, typically with university and scientific communities. It then jumped to non-contiguous areas in a hierarchical rather than a continuous manner.[8] We also expect that some population size threshold may exist with a certain density of potential pick-ups and drop-offs. The Population Group classes are based on Census Metropolitan Area (CMA) or Census Agglomeration (CA) population where respondents reside.[9]

Sex and Age

The difference between male and female Internet use rates tended to disappear when controlling for other factors such as age and education. With peer-to-peer ride sharing services, differences in use between men and women may not entirely disappear when controlling for other factors since there may be an element of perceived safety and security (i.e. certification of drivers).[10] With age, it has always been a key variable explaining Internet use with younger Canadian more likely to use the Internet. We observe a similar age effect with peer-to-peer ride sharing as Canadians under the age of 35 are more likely to report using such services compared to those in older groups.

Education

For Internet use, previous research found that the odds of using the Internet were nearly three time greater for someone having some post-secondary education than someone who has, at most, a high school education[11]. Using the same dichotomy, we find that use of peer-to-peer ride sharing services is more than twice as great for someone having some post-secondary education versus someone without.

Table 1 Use of Peer-to-Peer Ride Sharing Service by Selected Characteristics

Variable	Prevalence
Canadians	**7.0 %**
Population Group	
CMAs ≥ 1,000,000	10.1 %
CMAs 500,000 - 1,000,000	10.4 %
CMAs < 500,000	5.3 %
CAs	2.4 %
Non-CMAs	1.8 %
Sex	
Female	6.7 %
Male	7.2 %
Age Group	
18-24	13.5 %
25-34	14.6 %
35-44	7.7 %
45-54	5.0 %
55-64	3.0 %
65+	1.2 %
Education	
No post-secondary	3.8 %
Some post-secondary	10.2 %
Nationality	
Canadian	6.7 %
Non-Canadian	16.0 %
Labour Force Status	
Not Employed*	3.6 %
Employed	9.0 %
Earnings (per hour)	
$ 00.00	4.7%
$ 00.01 – $ 14.99	7.7%
$ 15.00 – $ 34.99	7.7%
$ 35.00 – $ 64.99	12.5%
≥ $ 65.00	21.0%

**Including not in the Labour Force (e.g. students, full-time parents, retirees)*
Highlighted: Reference group for logistics model

Nationality
Based on bivariate analysis, respondents were divided into Canadian (native born and landed immigrants) and non-Canadian. The rate of peer-to-peer ride sharing was much higher among non-Canadians. However, whether this difference remains when controlling for other factors such as age and education is not entirely clear a priori.

Labour Force Status and Earnings
We defined Labour Force Status as a dichotomy by dividing respondents into employed and those who are either unemployed or not in the labour force (e.g. students, pensioners, stay-at-home parents), with the former reporting a higher rate of peer-to-peer ride sharing service use. To an extent, this variable also captures the effects of 'earnings', a surrogate for income, which was excluded from the model. We tried several specifications with the earnings variable and it confounded other independents. It also reduced the

number of eligible observations since this question is only asked of those employed in the labour force. As such, it was decided to use Labour Force Status as a surrogate, albeit imperfect, for earnings.

A Binary Logit Model

In order to disentangle the significant factors, we specified a multivariate binary logit model in which the dependent variable takes on a value of 1 if the respondents reported using peer-to-peer ride sharing services during the reference period, or a value of 0 otherwise (see Equation 1). The independent variables were entered based on the review and an examination of the survey results (Table 1). We specified the categorical variables such that the reference group was always selected as the one with a prevalence closest to the national estimate. The model parameters (β) were estimated without using the sample weights, the results based on 98,472 observations.

We tried several combinations of independents for some models as well as defining categories differently for others. For the final model, we used standard definitions for population groups (CMA/CA) and age groups (LFS definitions). Further, variables were added to the model only if they enhanced the explanatory power as reflected by a reduction in the −2log likelihood. Lastly, the adjusted rho-squared statistic of 0.132 shows that there is a good explanatory power for this particular specification.

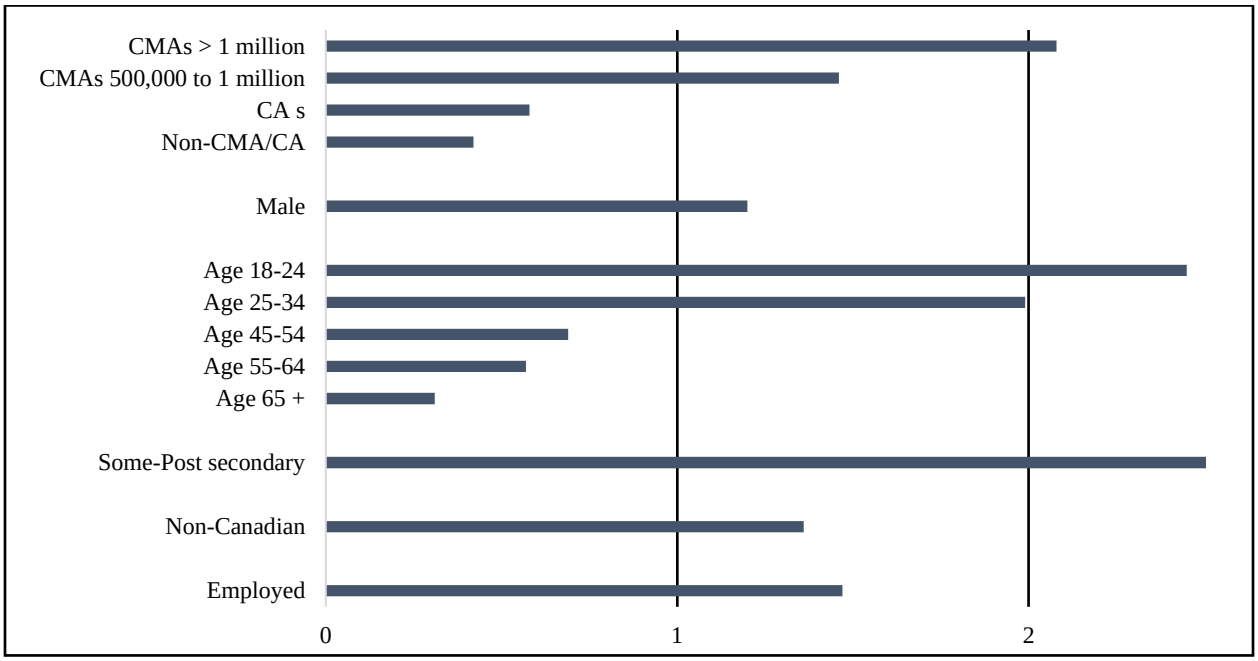
$$\textit{Uses peer-to-peer ride sharing services (1 or 0)} = \beta_0 + \beta_1 * Population\ Group + \beta_2 * Sex + \beta_3 * Age\ Group + \beta_4 * Education + \beta_5 * Nationality + \beta_6 * Labour\ Force\ Status + \varepsilon \quad (1)$$

Table 2 Use of Peer-to-Peer Ride Sharing Service Regression Results

Variable	Coefficient (β)	Significant	Odds ratio (e^{β})
Intercept	-4.106	Yes	na
Population Group			
CMAs ≥ 1,000,000	0.732	Yes	2.08
CMAs 500,000 - 1,000,000	0.377	Yes	1.46
CMAs < 500,000		** *Referent* **	
CAs	-0.553	Yes	0.58
Non-CMAs	-0.876	Yes	0.42
Sex			
Female		** *Referent* **	
Male	0.181	Yes	1.20
Age Group			
18-24	0.898	Yes	2.45
25-34	0.688	Yes	1.99
35-44		** *Referent* **	
45-54	-0.378	Yes	0.69
55-64	-0.564	Yes	0.57
65+	-1.158	Yes	0.31
Education			
No post-secondary		** *Referent* **	
Some post-secondary	0.978	Yes	2.66
Nationality			
Canadian		** *Referent* **	
Non-Canadian	0.284	Yes	1.36
Labour Force Status			
Not Employed		** *Referent* **	
Employed	0.388	Yes	1.48

With this final model, all independent variables were significant at the .01 level with coefficients in the anticipated direction (Table 2). Results are discussed in terms of the odds ratios (Figure 1).

Figure 1 Odds ratios of using peer-to-peer ride sharing services



As with Internet use in general, variations in the use of ridesharing reflects both "who you are" (i.e. age, education) and "where you are" (i.e. population size). That is, the type of individual more likely to use peer-to-peer ride sharing services may be more likely to reside in larger cities but, at the same time, such services are more likely to be available in larger cities. For example in Canada, there are currently 16 cities, all CMAs, offering Uber service[12].

Based on the population group where individuals reside, there is a clear delineation between smaller and larger groups, holding other factors constant. The odds of using a peer-to-peer ride sharing service was almost one and a half, and more than twice as high, for someone living in a medium (500,000 to 1 million), or large (> 1 million) city, respectively compared to some one living in a smaller city (CMA < 500,000). Conversely, the odds of someone using ridesharing services in a non-metropolitan area (CA or non-CMA/CA) was about one half that of someone from a smaller city (CMS < 500,000).

Men remain slightly more likely than women to use peer-to-peer ride sharing services after controlling for other factors. While we suspect this may reflect differences between sexes in the perception of safety and security, more research on this matter is needed. In term of age, there is a clear delineation in prevalence between young and old. The odds of using ridesharing services is about two times, and two and a half times, as high for individuals age 25 to 34, and age 18 to 24, respectively than someone 35 to 44 years of age. With the three other age groups, the odds ratio indicate that older individuals are progressively less likely to use these services.

For those individuals with at least some post-secondary education, the odds of using peer-to-peer ride sharing services are about two and a half times higher than individuals having, at best, a high school education. Even after controlling for other factors such as location and age, non-Canadians are more likely

to use such ride share services than are Canadians (native born and landed immigrants). Finally, the odds ratio of individuals employed in the labour force is about one and a half times higher than those either not employed or not in the labour force.

Summary

In the twenty-five years since the Internet was commercially launched, digital technologies have become pervasive. The challenge for statistical agencies has been to measure their uptake, use and impacts. With the emergence of the sharing economy, this challenge is exemplified by ridesharing services mediated by online platforms. To start measuring the use and impact, Statistics Canada asked Canadians the extent to which they used peer-to-peer ride sharing services and, during the one year reference period from November 2015 to October 2016, 7.0% of persons aged 18 and older in Canada were estimated to have used such services.

This use varied with both location (i.e. city size) and socio-economic characteristics of individuals. With few existing studies to provide guidance on the factors and socio-economic characteristics associated with the use of these services, we turned to evidence on the factors associated with Internet use. For instance, we anticipated peer-to-peer ride sharing services to be more of an urban phenomenon as well as a service more appealing to younger and more educated people. However, we did not anticipate that all of the bivariate differences in use would remain both significant and substantive in a model controlling for other variables.

With Internet use, an urban size effect independent of other factors was expected, given that infrastructure to deliver a signal – particularly broadband – would also be available in larger centres first. We thought a similar supply side effect would be less discernible with ride sharing services since the required vehicles (i.e. cars) and infrastructure (i.e. roads) exist everywhere, irrespective of city size. However, it appears that a certain population density threshold of supply (i.e. available drivers) and demand (i.e. potential customers) is required to make a peer-to-peer ride share service offering viable. More analysis can help determine this market threshold.

Statistics Canada can continue measuring the use and impacts of such services by adding "peer-to-peer ride sharing service" to some of its data sources. For example, it could become an explicit expense category in the annual Survey of Household Spending. This would enable us to determine if ridesharing is a complement or substitute vis-à-vis other modes such as taxi and transit as well as its association with motor vehicle ownership. Currently, expenditures on ridesharing services are captured as part of "Other local passenger transportation … carpooling, airport bus, limousine or ferry service, sightseeing tours".

In summary, peer-to-peer ride sharing services are poised to fundamentally alter urban transportation planning axioms, particularly with the advent of technology enabling the operation of autonomous vehicles. Consideration should therefore also be given to adding peer-to-peer ridesharing as an explicit response option for the question on usual mode of transport to work as part of the Place of Work module in the 2021 Census of Population. This module in particular provides key benchmark data used in mode choice modeling by urban transportation planners in many municipalities across the country.

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Endnotes

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[9] A CMA (CA) consists of one or more neighboring municipalities with a population of at least 100,000 (10,000) situated around an urban core of 50,000 persons. Note however, that the ride sharing service could have taken place anywhere, not necessarily in the community where the respondent resides.
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