Understanding the Influence of the Built Environment and Zonal Attributes on the Relationship between Public Transit and Ride Hailing Services

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Abstract:

Since their introduction into the market, ride-hailing services (such as Uber and Lyft) have had a profound impact on transportation networks and have challenged traditional perceptions of mobility. The growing adoption of these services has impacted other modes of travel, including public transit. The increased utilization of ride-hailing services has the potential to negatively impact transit ridership, and by extension, fare revenues collected by transit agencies. The prospect of declining ridership should concern transit agencies, as many large agencies rely on fare revenues to help fund operations. Consequently, the nature of the relationship between ride-hailing and transit services, and the factors that influence it, should be of interest to both policymakers and transit agencies.

Although ride-hailing services have only recently entered the market, there is a growing body of research on their impacts on the utilization of transit. The literature reveals a complex relationship between the two services; some studies find that ride-hailing complements transit services, while others reveal a substitutive relationship [1]. Due to the lack of publicly-available data on the use of ride-hailing services, many studies that investigate the relationship between the two services are based on data collected through surveys, such as [2].

Among studies that utilize information on the origins and destinations of ride-hailing trips, two broad categories of approaches exist. The first involves analyzing said trips with respect to the corresponding transit trip [2]. The second involves modelling the total number of ride-hailing trips generated at an aggregated (i.e. zonal) level [3], which is a fairly common approach. Using zone-level values to analyze the relationship between transit and ride-hailing services may produce results that fail to take the larger context into account. This is partially due to the difference between the respective orders of magnitude of zone-level transit and ride-hailing trips. The use of relative standings allows the relationship between and usage of transit and ride-hailing to be quantified and analyzed using the same frame of reference.

To our knowledge, there has yet to be a study that analyzes the factors that influence the relative standing of the trips generated in a zone in this context. This study aims to contribute to the literature by identifying the factors that affect the relative standings of ride-hailing and transit trips originating from each traffic analysis zone (TAZ) in the City of Toronto. These standings will be defined by comparing the number of trips originating in a given TAZ to the trips originating in each TAZ within the study area. The number of ride-hailing and transit trips originating in each TAZ will each be expressed in terms of a ranking. Two rankings will be used – one defined based on percentile thresholds (e.g. low, moderate, high) and another defined with respect to the mean (e.g. below or above).

This study will utilize two sources of data. The number of transit trips originating from each TAZ on a typical weekday will be obtained from the 2016 Transportation Tomorrow Survey (TTS), a cross-sectional household travel survey that has been conducted every five years since 1986. The 2016 TTS contains information on 395,885 persons and 798,093 trips [4]. The number of ride-hailing trips originating in each TAZ will be determined using data provided by ride-hailing companies pertaining to their operations in the City of Toronto. This dataset contains roughly 23 million detailed spatio-temporal records of each ride-hailing trip made between September 2016 and September 2018.

The first stage of this research will explore variations in the respective rankings of transit and ride-hailing usage in Toronto, using summary statistics and visualizations. The number of ride-hailing and transit trips corresponding to each TAZ will be converted to a pair of ranks, which will be plotted using GIS software. These plots will be used to identify transit-dominant (i.e. high transit and low ride-hailing usage), ride-hailing-dominant, and contested (i.e. equal rankings) zones. The second stage of the research will investigate the effects of zonal attributes (land usage, socio-demographics, and transit service metrics) on the relative standings of transit and ride-hailing trips. A number of statistical model formulations and combinations of explanatory variables will be tested. The ride-hailing and transit rankings will be modelled both independently and jointly as a function of zonal attributes, using the ordered probit and logit formulations. The results of the independent models will be used to quantify the effects of different attributes on the relative standings of the usage of transit and ride-hailing. The results of the joint model will provide insights into the role that the utilization of one service plays in the utilization of the other.

The results of this study will offer insights into the role that the built environment and zonal attributes play in the utilization of transit and ride-hailing services, as well as the relationship between the two. These insights can be used to inform policies and operational adjustments that can help agencies reduce the substitution of transit with ride-hailing and to nurture cases where ride-hailing complements transit services. This would allow agencies to take more of a proactive approach to identifying areas where ridership may be cannibalized by ride-hailing services, while also guiding infrastructure investments and policies that aim to encourage a complementary relationship between the two services.

Relevant References:

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