



Transit use and the work commute: Analyzing the role of last mile issues



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ABSTRACT

This paper examines the role that public transport last mile problems play in mode choice decisions of commuters, while controlling for trip, built environment, and decision maker related variables. Last-mile problems arise due to lack of adequate connectivity between transit stops and trip origin or termination points. The paper is motivated by previous literature which has pointed out that high-quality public transit needs to consider end-to-end connectivity from trip origins to destinations. In contrast to previous work on transit last mile problems, which has focused on physical distance and sidewalks to transit stops, we consider a wider range of area factors including transit availability, job accessibility, parking costs, the quality of the pedestrian environment and risks to pedestrians from vehicular traffic, and social characteristics such as street-level crime. Using a discrete choice model, our goal is to unpack ways in which such factors contribute to the last-mile problem in home-based work trips, while controlling for these wider range of factors as well as the usual variables such as cost and trip time that inform mode choice. We find that the prevalence of non-domestic violent crimes reduces the odds of using all types of non-motorized alternatives as well as transit that is accessed either by walking or driving. Using compensating variation to measure welfare changes, we show that there are significant benefits that could be brought to transit service users through increasing safety in the transit access trip. By separately controlling for origin and destination transit accessibility, we show that improved destination accessibility significantly boosts transit use to a greater degree than increases in origin level accessibility. These findings argue for improving accessibility and related job densities at employment centers.

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1. Introduction

A recurring theme in the transit planning literature is how transit could play a larger role as a transportation mode in cities and metropolitan areas. The solutions suggested range from changes to the built environment to support higher-quality transit, to altering the costs of transportation alternatives to make transit more competitive and appealing. Part of making transit appealing has to do with the transit ride itself: fare levels, service frequency, the quality of the waiting environment, and in-vehicle amenities. However, it is also important to pay attention to the built and social environments between transit stations or stops and home, work, or other locations where people's travel originates or eventually terminates. Challenges posed by built and social environment factors in the first or last leg of a trip that involves transit as the line-haul mode is often called the "last mile problem" and it can have an important impact, not only on the decision

to use transit for the entire trip but also on how transit users reach their boarding locations or their final destinations after alighting from transit.

Last mile problems, particularly physical distances between stations and trip origins or destination points that are greater than what people are typically willing to walk, have been documented for a long time as a critical factor affecting transit use. While transit operators have some control over the last mile experience, mainly by altering the location of transit stations for improved proximity to origin or destination points of demand, and by improving the feel and quality of stations, the issues that affect the quality of the last-mile trip are broader. In addition to proximity, access conditions depend greatly on multiple characteristics of the built and social environment in which the last-mile trip takes place. These include physical connectivity issues such as the absence of comprehensive and connected sidewalk or bicycle lane systems, place-based barriers such as safety risks from vehicular traffic, and social and perceptual factors such as the absence of retail and employment opportunities and the presence of deterring streetscapes and street-level crime in transit accessways or at stations. There are myriad other factors, including lack of dedicated last-mile solutions such as connecting transport or lack of information, that can deter access to transit from trip origins or egress from transit to final destinations. The last mile problem, therefore, is a complex multidimensional problem that has physical,

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place-based, social, and perceptual components; addressing this problem requires a multi-pronged approach consisting not only of transportation and urban design solutions but also broader social policies.

Our goal in this paper is to unpack the factors that contribute to the last mile problem in the context of mode choice, while controlling for the usual variables such as cost and trip time that inform decision making. The paper builds on our previous work to understand empirically the role that neighborhood factors play in the choice of travel mode for home-based trips. In an earlier paper (Tilahun et al., 2013), we looked at how car-owning transit users accessed transit boarding locations. The results showed that much of the transit access mode choice is explained by variables such as the travel time of the access mode and the characteristics of the decision maker (e.g., age, number of vehicles). We also found that increases in neighborhood-level factors such as population density and percentage of minority populations were associated with increases in the odds of walking to the boarding location relative to driving, while the availability of parking at transit stations was associated with a decrease in the odds of walking as compared to driving to the boarding location. In another paper, using a stated preference approach, we explored the variables that influence walk-transit access to stations (Tilahun and Li, 2015) and found that walk times, perceptions of crime, and sidewalk availability were important in influencing choice.

In this study, we consider a broader set of travelers (pedestrians, transit users, drivers, etc.) and investigate the role that different individual, household and social factors, the built environment and other place-based factors, as well as trip characteristics, influence mode choice. While travel mode choice has a voluminous literature, detailed characteristics of the physical and social conditions at the trip origin and destination, which potentially act as last mile barriers to using specific modes, have been considered to a lesser degree. Alongside more traditional variables, such as travel time and out of pocket costs, we characterize the quality of the overall trip that each alternative transportation mode provides, considering pedestrian safety (as measured by crash statistics), crime levels (as given by the crime statistics in the area), degree of pedestrian friendliness (as measured by a composite index), and transit accessibility (measured by a cumulative opportunities measure). This approach allows us to estimate the degree to which these attributes influence mode preferences, thereby adding to recent works that have paid increasing attention to last mile issues and explored potential solutions (Shaheen and Finson, 2003; Brons et al., 2009; NNCA, 2009; Cheng et al., 2012; Wang, 2012).

The overall policy motivation is to understand physical and social barriers to the last mile problem and to present an approach by which different configurations of last-mile barriers may be identified, measured, and addressed towards the goal of boosting transit ridership. For example, we analyze the extent to which transit access by different modes of transport are related to socio-demographic factors and how they vary between peak and off-peak hours. We also assess the extent to which varying levels of origin and destination accessibility surrounding transit facilities support various “transit access modes” such as walking, bicycling, or shared rides for transit access or egress trips. The analysis allows us to identify policies and the mix of transportation solutions needed to improve last mile problems. Additionally, we analyze how potential transit users are likely to value non-transportation programs that reduce social barriers within the context of the last mile problem, with a particular focus on reducing station-area crime. This multi-pronged strategy allows us to come up with a comprehensive approach to understanding the last-mile problem and the mix of solutions needed in areas with different types of last mile problems.

A key element in the analysis is the amount and types of data that we have gathered to characterize the environments in which mode-choice decisions are being made. Recent years have seen much wider availability of public and private data that characterize urban environments. We take advantage of these increasingly available data sources to characterize the built and social environments, as well as the performance of the different transportation systems available to users at fairly disaggregate

geographies to study how these affect mode choice behaviors. We use, for example, crime data available from the City of Chicago's open data portal to evaluate the level of crime prevalence around transit stations. We exploit the potential offered by Open Street Maps and GTFS data to compute fairly detailed travel times and transit accessibility levels. We leverage parking rate information that is made available by different web portals to create a better picture of the costs travelers face for parking when destined to different parts of the metropolitan area. By combining these sources of data, along with traditional sources such as those collected by planning agencies and the Census Bureau, we build a more realistic image of the urban context within which travel decision makers are making choices.

The rest of the paper is organized as follows: in Section 2, we present background information on factors explaining mode choice with a particular focus on trip-maker's neighborhood-level factors, and on relevant work on the last-mile barriers in passenger transportation. Section 3 describes the research approach and the data used for this study. The analysis is presented in Section 4, and results are presented in Section 5. Section 6 provides a summary and discussion based on the model results.

2. Background

A voluminous literature has considered factors that affect traveler's choice of mode of transportation. Factors generally considered important include: (1) mode-specific costs and level of service factors including travel time, out-of-pocket cost, waiting time or generalized cost of travel by alternative modes, parking availability and cost, service frequency, time-of-day of transit service and hours of operation; (2) household-level factors such as household size, number of children, income, availability of personal vehicles, race and ethnicity, and related factors; (3) individual traveler-level factors including gender, age, employment, schedule, need to provide child or other care services; and (4) land-use, urban design and accessibility factors, including land-use mix, availability of sidewalks and other pedestrian factors, population and/or employment density, accessibility to job or social opportunities, and other related factors.

Several authors have noted that the built environment and socio-demographics are important in influencing people's mode choices (Dieleman et al., 2002; Ewing and Cervero, 2001, 2010; Frank et al., 2008). Using the results of over 200 studies, Ewing and Cervero (2001) synthesized existing literature on the built environment and travel behavior and suggested that both socio-demographic and built environment variables affect mode decisions. Others have also examined neighborhood environments at either origin or destination, or both, in their models. For example, Cervero (2002) and Rajamani et al. (2003) assessed the impact of the built environment at origin and destination on mode choices and concluded that land-use patterns would encourage walking and reduce SOV commuting. Chen and McKnight (2007) analyzed the relationship between density and mode choice for home-based tours by considering three dimensions of the built environment: population and employment densities, job accessibilities, and distance to transit stops. They concluded that the built environment is significant in influencing mode choice, but that the level of influence varies at origin and destination, particularly with density at destinations being more important compared to neighborhood characteristics at origins.

Some papers also separate mode choice for different trip purposes or different commuter groups. Cervero and Radisch (1996) compared the influence of the built environment on mode choice for both work and non-work trips in two neighborhoods in the San Francisco Bay area. They found that neighborhood characteristics were more influential on non-work trips than work trips. Plaut (2005) looked at factors influencing people's non-motorized mode choice including neighborhood environment characteristics. He separated homeowner and home renter commuters and emphasized that home renters have greater flexibility

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