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The impact of real-time information on bus ridership in New York City

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ABSTRACT

In the past few years, numerous mobile applications have made it possible for public transit passengers to find routes and/or learn about the expected arrival time of their transit vehicles. Though these services are widely used, their impact on overall transit ridership remains unclear. The objective of this research is to assess the effect of real-time information provided via web-enabled and mobile devices on public transit ridership. An empirical evaluation is conducted for New York City, which is the setting of a natural experiment in which a real-time bus tracking system was gradually launched on a borough-by-borough basis beginning in 2011. Panel regression techniques are used to evaluate bus ridership over a three year period, while controlling for changes in transit service, fares, local socio-economic conditions, weather, and other factors. A fixed effects model of average weekday unlinked bus trips per month reveals an increase of approximately 118 trips per route per weekday (median increase of 1.7% of weekday route-level ridership) attributable to providing real-time information. Further refinement of the fixed effects model suggests that this ridership increase may only be occurring on larger routes; specifically, the largest quartile of routes defined by revenue miles of service realized approximately 340 additional trips per route per weekday (median increase of 2.3% per route). Although the increase in weekday route-level ridership may appear modest, on aggregate these increases exert a substantial positive effect on farebox revenue. The implications of this research are critical to decision-makers at the country's transit operators who face pressure to increase ridership under limited budgets, particularly as they seek to prioritize investments in infrastructure, service offerings, and new technologies.

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1. Introduction

Public transit plays an important role in urban transportation systems. Transit can help to combat roadway congestion, decrease gasoline consumption, and reduce carbon dioxide emissions in metropolitan areas (Schrank et al., 2012). Other benefits of transit include providing personal mobility options for those who cannot or choose not to drive (American Public Transportation Association, 2014) and supporting active mobility and its subsequent positive health impacts

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(Besser and Dannenberg, 2005; Litman, 2014a). Despite these benefits, transit agencies in many American cities struggle to increase (and in some cases, maintain) ridership levels as they compete with other modes of passenger transportation, particularly single-occupancy motor vehicles.

In order for public transit to be a viable option for travelers, it must be reliable, accessible, and presented in an understandable manner, among other things (Walker, 2012). These factors can potentially be improved with new customer information systems, which transit agencies are rapidly implementing. The widespread adoption of mobile devices by transit passengers has led to growing reliance on these devices and increased expectations for transportation information provided in personalized formats. Moreover, these applications are frequently more cost-effective for transit agencies than alternative methods of displaying this information, such as dynamic message signs. Consequently, the availability of web and mobile "apps" providing transit information – particularly real-time vehicle location/arrival information – has increased at an unprecedented pace over the last decade (Schweiger, 2011).

Given the rapid increase in the availability of transit apps, quantifying the impact of real-time transit information on actual travel behavior is essential for transit operators to make responsible decisions regarding the implementation of these systems and for planning agencies to properly plan for future scenarios. Because transit travel is affected by numerous factors, such as macroeconomic conditions and the weather, previous studies have had difficulty isolating changes in transit ridership due to real-time information.

This paper relies on a natural experiment that occurred in New York City beginning in 2011, when the transit agency began to gradually deploy real-time information on its buses operating in each borough of New York City on a by-borough basis. This deployment pattern enables use of regression techniques that control for unobserved heterogeneity in route-level ridership and time-dependent effects, isolating the effect of real-time information. The results of this analysis indicate that real-time information is associated with an increase of approximately 118 unlinked trips per route on an average weekday, although the ridership increase appears to be occurring primarily on the largest bus routes.

This paper proceeds as follows. First, prior research into the impacts of traveler information systems on transit passengers is presented to provide a basis for the contribution of this research. Next, the methodology for data collection and econometric analysis is discussed, followed by results and revenue implications. The final section contains a discussion of study limitations, opportunities for future research, and concluding remarks.

2. Prior research

Real-time information (RTI) refers to the tracking of transit vehicle locations and/or predicted arrival times for vehicles at stops and/or stations, which is typically updated at least once per minute. One area of prior research pertains to RTI displayed on signage at stops or in stations (Hickman and Wilson, 1995; Dziekan and Kottenhoff, 2007; Kamga et al., 2013). Recently, the practice of providing RTI to transit riders via web-enabled and mobile devices has become increasingly ubiquitous (Schweiger, 2011), and a growing body of literature aims to understand the rider impacts of RTI provided via personal devices. Some of these studies have utilized simulation modeling techniques (Fries et al., 2011) and others have employed stated preference techniques (Tang and Thakuriah, 2010), in which researchers pose hypothetical scenarios to survey participants as opposed to directly observing their behavior. The following brief literature review focuses on research that evaluates actual transit rider behavior (as opposed to simulation or stated preference methods) because these studies are most likely to provide the concrete conclusions needed for decision-makers at transit agencies. Section 2.1 briefly summarizes key rider benefits of using RTI, and Section 2.2 provides a detailed review of literature pertaining to changes in transit travel associated with RTI.

2.1. Prior research on the rider benefits of real-time information

Previous studies of transit riders using RTI have found some important benefits. First, RTI can help passengers adapt to unreliability of transit service, which was an important finding of a recent survey of current and former transit riders in the San Francisco Bay Area (Carrel et al., 2013). Second, RTI users can time their departure from their origin to minimize wait times at stops/stations; moreover, real-time information can help to reduce the perception of time while waiting at stops/stations. In Seattle, Washington, a recent study of bus riders using RTI found that their actual wait times were almost 2 min less than those of non-users, and perceived wait times of RTI users were approximately 30% less than those who did not use RTI (Watkins et al., 2011). Other passenger benefits of RTI include increased perception of personal security and increased satisfaction with transit service (Zhang et al., 2008; Ferris et al., 2010; Gooze et al., 2013).

2.2. Prior research on the ridership impacts of real-time information

If RTI users can adapt to unreliable service more easily, spend less time waiting, feel safer, and/or are more satisfied with overall service, it follows that they may make more trips on the transit system, either by choosing transit over alternative modes or making trips that they would not have made otherwise. Therefore, a few recent studies have aimed to understand the impacts of RTI on transit travel.