Transportation Research Part A 66 (2014) 238–250

Contents lists available at ScienceDirect

Transportation Research Part A

journal homepage: www.elsevier.com/locate/tra

Policy analysis of third party electronic coupons for public transit fares

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ARTICLE INFO

Article history:
Received 16 May 2013
Received in revised form 14 May 2014
Accepted 29 May 2014
Available online 24 June 2014

Keywords:
Public transport
Automated fare collection
Marginal cost theory
Revenue management
Game theory
Electronic coupon

ABSTRACT

Mobile technologies are generating new business models for urban transport systems, as is evident from recent startups cropping up from the private sector. Public transport systems can make more use of mobile technologies than just for measuring system performance, improving boarding times, or for analyzing travel patterns. A new transaction model is proposed for public transport systems where travelers are allowed to pre-book their fares and trade that demand information to private firms. In this public-private partnership model, fare revenue management is outsourced to third party private firms such as big box retail or large planned events (such as sports stadiums and theme parks), who can issue electronic coupons to travelers to subsidize their fares. This e-coupon pricing model is analyzed using marginal cost theory for the transit service and shown to be quite effective for monopolistic coupon rights, particularly for demand responsive transit systems that feature high cost fares, non-commute travel purposes, and a closed access system with existing pre-booking requirements. However, oligopolistic scenarios analyzed using game theory and network economics suggest that public transport agencies need to take extreme care in planning and implementing such a policy. Otherwise, they risk pushing an equivalent tax on private firms or disrupting the urban economy and real estate values while increasing ridership.

1. Introduction

Urban sustainability depends on making public transport systems attractive to travelers (Kennedy, 2002; Sinha, 2003). Without high ridership, public transport requires costly subsidies (Parry and Small, 2009) partly because few riders results in lower operating frequency and consequently higher user costs such as wait and access time (Mohring, 1972). However, many transport systems around the world operate with low ridership outside of the peak periods, and in some cases for all periods. This problem is especially endemic in low population density suburban communities in the United States. Of course, there are exceptions where transit ridership is so high compared to the available capacity that congestion at a station or in a vehicle is a recurrent problem (Lam et al., 1999; Hamdouch and Lawphongpanich, 2010). For fixed route and fixed schedule services, low ridership during off-peak periods, combined with demand uncertainty, can lead to lower cost efficiency of a system.

Ridership concern is even greater when operating demand responsive transit (DRT) systems (Schofer et al., 2003): paratransit, dial-a-ride, or personal DRT. These systems operate with relatively smaller capacity vehicles compared to buses or rail, and they can spend significant portions of their time running empty after dropping off passengers.

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http://dx.doi.org/10.1016/j.tra.2014.05.015
0965-8564/

Proper revenue management, which involves dynamic pricing and marketing strategies to maximize revenue, can improve ridership and other system performance measures (Li et al., 2009). As those authors pointed out, the challenge that the public transport industry faces compared to the airline or car rental industries is that it is an open-access system that does not require pre-booking. The result is that travel demand and behavior remain difficult to forecast. In cases where reservations can be made, such as intercity rail, revenue management models are being developed (e.g. Cirillo et al., 2011). However, urban public transport systems at best can implement pricing differentiation strategies—time-based pricing, directional pricing, regional pricing, usage-based pricing, or demand-based pricing (Li et al., 2005)—because of the inherent open access structure.

Technology may perhaps change this outlook. Automated fare collection (AFC) systems have enabled many of the pricing strategies presented by Li et al. (2005). Smart card technologies reduce the amount of time it takes to board a transit vehicle, which can ultimately improve operational efficiency (Tirachini and Hensher, 2011; Tirachini, 2013). The technology allows transit system performance measures to be collected (Morency et al., 2007), and for travel patterns to be estimated (Chakirov and Erath, 2011; Nassir et al., 2011; Munizaga and Palma, 2012).

With the growing use of mobile devices, further opportunities in fare collection are possible. In Helsinki, Finland, public transport users have been able to pay their fares with their mobile phones since 2001 (Mallat et al., 2008). Böhm et al. (2005) explained the practical advantage of paying fares through mobile devices, which reduces the cost of transit infrastructure for AFC and also presents opportunities for location-based services to link with fare payment. Páez et al. (2011, 2012) saw an opportunity to engage private sector with the transit demand information available from smart cards, and proposed spatial analysis methods to identify local business opportunities or to market to particular demographics.

If we consider the near-future scenario where the majority of the population owns mobile devices that can purchase fares offsite from a transit system, what can be done to improve ridership? Besling et al. (2002) introduced the idea of using smart cards to allow payment of electronic coupons. With mobile devices, there is potential for a new form of fare transaction model where the public transport system's revenue management can be outsourced to third party private firms, as suggested by Páez et al. (2011) in the form of rebates, offers, and/or loyalty points. These firms would issue electronic coupons to travelers to subsidize their fares. Traditional coupons already exist, but only in limited form, for example for intercity bus services to take tourists to casinos. In an urban area, traditional coupons would not work because there is no centralized control; for example, a traveler may just take a paid transit fare to multiple vendors at a destination and ask for rebates if they all participated in the model. This is why this business model is used by intercity destinations like casinos but has not yet found its way to urban destinations. Even existing businesses that currently provide free transportation service to their customers can benefit, because they are investing in the free transportation due to insufficient capacity or demand from other modes like driving. In these cases, the businesses would be transferring the cost to an alternative that may be less costly while increasing transit ridership.

In this example of a public-private partnership, the public transport system serves as a platform for fare transactions. Firms that operate large destinations for travelers, such as a sports stadium, a theme park, or big box retail, can issue electronic coupons on the platform. Users are allowed to book their transit fares in advance (pre-book), and in doing so, have the option to claim a coupon if they intend to travel to that destination. When they arrive at the destination and check in to that location, the platform gets informed of completion of the travel transaction, and their trip fare is reimbursed in the amount of the coupon. The advantages of such a system are three-fold: (1) the firms can attract more customers, or may seek customers arriving by other modes due to limited parking availability; (2) ridership goes up for the transport system; (3) and fares can be subsidized for the travelers. The need to pre-book ensures that random strangers cannot go to a participating firm and request a coupon. This model may be used by firms to encourage their employees to commute by public transit, although it has much more applicability to retail and leisure destinations where additional customers translate directly to increases in revenue, and because peak periods may already suffer from congested transit service. Because of the intended use, the ridership increase is likely to occur during off-peak periods as opposed to peak commute periods, resulting in increased efficiencies in the public transport system. It is a situation that can benefit all parties involved. This transaction model is illustrated in Fig. 1, although more sophisticated processes may also be implemented that ensure more secure exchange of travel demand for purchases (e.g. providing the coupon if a customer spends X dollars). These are implementation and design issues that require testing in practice to refine.

The purpose of this study is to gain a deeper insight to the proposed transaction model and to answer several policy-related research questions. First, a marginal cost model is designed to evaluate the consumer welfare potential of the transaction model, which is not just applicable to e-coupons, but also to traditional coupons like in the example earlier. Should a public transport agency allow travel demand to essentially be commoditized and traded with third party private firms? Under what conditions would it make sense to do so? The marginal cost model is used to illustrate how the transaction model can be especially beneficial to DRT systems. An important policy question is how much regulation the transport agency should have on deciding which firms can enter this "travel demand e-coupon" market. Oligopolistic games are constructed between two firms allowed to offer coupons (note that even though the coupon provision is oligopolistic, the firms themselves are assumed to operate within a competitive market), and then for a network of M traveler origins and N destination firms to evaluate this policy.