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A modified model to curb fare evasion and enforce compliance: Empirical evidence and implications

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ABSTRACT

Fare evasion is a major problem for transit companies due to lost fare revenues and damage to their corporate images. Therefore, the establishment and proper management of ticket inspection teams deployed to tackle fare dodgers is highly important and represents a severe challenge. In this paper, an existent profit maximization model for estimating the optimum level of inspection has been extended, calibrated, and tested in a real case, using data available from an Italian transit operator, resulting from 98 days of checks and 3659 completed on-board interviews. Given the current network-wide inspection level per single verifier, and considering the level of fines currently applied, the optimal value of the total inspection rate is found to amount to 4.5%. The model provides empirical evidence towards understanding the fare evasion problem, besides highlighting the need for collaboration with the managers of the transit company. An overview of the manipulation of some control variables related to risk perception and the main implications of the findings are presented to transport companies using "honour" ticketing systems.

1. Introduction

Fare evasion is the passenger's irregular possession or lack of a ticket. It is gaining relevance among Public Transport Companies (PTCs) because, especially in the current economic downturn, the number of fare dodgers is well beyond the physical limit that companies can find acceptable. The losses in terms of lower fare revenues and damage to corporate image are relevant. Based on data provided by 31 PTCs from 19 states worldwide, representing about 300,000 employees and 20 billion passengers per year, a study estimated that the phenomenon costs PTCs over 1 billion euros per year (Bonfanti and Wagenknecht, 2010). Fare dodging is also at the root of a social inequity system, aggravating transport agencies' subsidization needs and forcing paying passengers to increase their expenditures in order to counter the financial effects of fare evasion. Finally, fare evasion is also associated with increased levels of violence on public transport, which might also have negative economic repercussions on PTCs.

The phenomenon potentially affects different public transport systems, even if not to the same extent (Kooreman, 1993). While for some of these – air, sea transport, and so forth – the presence of several check procedures makes it almost impossible to evade fare payment, the same does not apply to others (especially within metropolitan areas). For example, in massive systems such as subways, the payment regularization occurs before boarding, by forcing the passenger to pass through turnstiles. This produces lower fare evasion rates than in other collective systems. On buses, trolleybuses, trams, and so on, the payment regularization occurs once on board via a vehicle ticket machine. This feature makes it easier to fare dodge and

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increases the likelihood that users who usually pay their fares will imitate the evasion propensity, resulting in the phenomenon spinning out of control (Clarke et al., 2010). In these latter transport systems, fare evasion problems emerged first during the 1960s in Europe and soon after in the U.S. (Diebel, 1981). The progressive abandonment of conductors and their substitution with honor ticketing schemes, where a passenger is supposed to voluntarily self-cancel his or her ticket whilst respecting ticket-use limitations, is widely acknowledged to have aggravated the problem.

The change in ticketing systems has resulted in significant operating savings for PTCs, besides further benefits in terms of the adoption of technologies and design of buses. On the other hand, the elimination of a continuous and systematic monitoring system has increased the likelihood of passengers evading fares, especially for short trips. It seems evident that the transition between the two systems implies the need for PTCs to answer the following question:

- What is the optimum inspection level to be adopted on the network?

The contribution of this paper is to answer this question by improving an existing well-structured analytical model (Boyd et al., 1989), adapting it to a case study, and using real data acquired through surveys and made available by a local PTC. In this sense, the paper aims to provide mid-sized PTCs with an effective tool to be used to change the control policy. The model explains the main parameters which form the profit and is related to both the objective probability – set by the PTC – and the subjective probability – perceived by the user – that a passenger will be inspected. The two probabilities are dependent on the level of control and the costs associated with it. As a result, the fare evasion problem has been formulated from both the PTC's and the user's viewpoint. Both the actual revenues and the costs of a PTC (resulting from the inspection activities) and their relations with the control perceptions of users are considered and incorporated in order to provide empirical evidence that can be used by PTCs. Although the dataset is not huge, the results make it possible to determine the optimum number of inspectors to be employed on an average working day. However, since the appraisal of the optimal number of inspectors is a function of different attributes, the PTC could hardly accept the results *tout court*. Thus, the results will be referred to those factors which vary according to the different policies implemented by PTCs.

Following a brief review of the literature on the topic, the study focuses on the model specification and resolution, besides its application to a bus network managed by a medium-sized PTC. It operates within a metropolitan area characterized by a low-to-medium residential density and by urban and suburban lines travelling across it. Some actions required to limit the size of the inspection teams and their implications are also discussed. Finally, the conclusions and scope for further research are presented and identified.

2. State of the art

Some papers have highlighted how the study of fare evasion in public transport is mostly dealt with from the perspective of *security* rather than its economic implications (e.g. Sherman, 1990; Del Castillo and Lindner, 1994; Smith and Clarke, 2000; Bijleveld, 2007). However, since fare evasion has always had economic impacts on transit agencies' budgets, it is important to shed some light on this specific aspect, making use of models and statistical data. Hence, it could be beneficial to have a model that is able to include primary data and to determine the optimum level of inspection for a PTC.

2.1. Existing approaches

The limited, and in many cases outdated, economic literature on fare evasion on public transport has led to the formulation of some theoretical models linking the decision to evade the fare to the maximization of a person's own utility. Three approaches have been proposed in order to determine the optimum level of inspection: (1) linking a fare dodger's probability of being caught to the amount of the corresponding fine; (2) maximizing the PTC's profit; and (3) using game theory based modeling. The first approach is described by Polinsky and Shavell (1979), Kooreman (1993), and Bootheway (2009). The first study assumes that all users are identical, except for the different benefits derived from travelling without a ticket. The second differentiates passengers according to their different attitudes to risk associated with the decision to evade the fare and distinguishes among risk-neutral, risk-averse, and risk-loving passengers. A theoretical expression of a function of the "reservation inspection probability" is presented for each of the above-mentioned types of passengers, manipulating specific utility functions. The third investigates the problem related to the definition of the optimal fine, stressing that this value depends on the demand elasticity to the amount of the fine: some users, considering a possible fine increase, may decide to always evade the fare and not to pay the prospective fine if they are caught. The second approach is employed in Boyd et al. (1989), using a model which highlights the relationship between the PTC's profit and its inspection level, expressed as the number of ticket inspectors in service. In case of risk neutrality for potential evaders, they employed two functions representing the distribution of the subjective and objective probabilities of being inspected, in order to estimate the optimum number of inspectors. The third approach is used by Avenhaus (2004), who, taking into account the amounts of the fine and fare, addressed the problem of the optimal level of inspection through the application of "inspection games" simulating a situation where an inspector checks whether a passenger abides by the rules.

All these approaches contain some numerical examples but lack empirical contributions to support the theories developed. Kooreman (1993) attempts to analyze the theory of fare evasion with empirical data, but the dataset is limited