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Title UNDERSTANDING FARE EVASION IN SANTIAGO'S PUBLIC TRANSPORT

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Abstract Fare evasion is a problem in many public transport (PT) systems. A survey from the *International Association of Public Transport* found that fare evasion averaged 4.2% across their sample of primarily bus services in 31 systems and 18 countries (Bonfanti & Wagenknecht, 2010). Policies to reduce fare evasion are generally aimed at improving control systems and increasing fines for offenders (Killias *et al.*, 2009). In the bus component of Santiago de Chile's transit system the average evasion rate is over 20% and the highest values are reported in low-income areas (Directorio de Transporte Público Metropolitano, 2013). However, limiting the explanation of such a complex phenomenon to only income level can overestimate the benefits of some policy measures and underestimate others. The main objective of this paper is to identify some of the factors behind the high levels of evasion on buses in Santiago, Chile, with the purpose of guiding public policy aimed at reducing this behaviour.

In a recent study done in Reggio Emilia (Italy), exploring the high level of evasion on buses (43%), Buccioli *et al.* (2013) analysed evasion behaviour at an individual basis using probit models. The independent variables were mostly socio demographic characteristics (i.e. gender, age, education, frequency of travel and proxy variables for individual income); others related to the characteristics of the bus stop and the level of service on public transport were also discussed, but not considered in the final model. We add to the literature by focusing on variables that describe the bus stops, boarding patterns, bus type, and quality of public transport services that should be considered in a study of evasion.

To explain evasion we used a methodology based on econometric models, which has been applied successfully in areas of high relevance to public policy (Shields & Huang, 1995). This allowed us to identify variables describing the conditions on the PT system and passenger behaviour at times of higher evasion. In all models estimated, the dependent variable was defined as the amount of evasion at a door of the bus, at a particular time of the day and stop in the city. We estimated multiple regression models, including two types of count regression models, Poisson and the negative Binomial.

For all models we selected a set of explanatory variables based on the following three criteria: first, the consistency and our expectations of the signs of their estimated parameters; second, the statistical significance of the variables analysed; and third, the good of fitness of the models (Ortúzar and Willumsen, 2011). These models consider the entrance door, number of people who enter and leave by each bus door, number of doors, bus occupancy, time of day when passengers enter (rush hour), existence of evasion control due to pay zones stops, area where the bus stop is located. However, the validity of the results obtained with the models depends on whether the models assumptions are not violated. This analysis was done for each type of model and, finally, the Binomial Regression was selected as the best specification giving the most consistent results. To analyse the impact of the explanatory variables on the dependent variable in count regression models was used the Factor Change(FC) analysis. In our study, FC represents the percentage change in the expected number of evasions at a bus stop to a unit change in one of the independent variables (Frome & Checkoway, 1985). Thus, this factor represents a "pseudo-elasticity" which is calculated for each explanatory variable. It should be noted that the dependent variable changes are calculated *ceteris paribus* (i.e. analyzing the impact of one independent variable while all others are held constant).

We found that fare evasion rates on buses increase as: (i) more people board at a bus stop; (ii) if people enter by a rear door; (iii), if buses have high occupancy (and have more doors), (iv) if more people alight. Additionally, after controlling for these variables (*ceteris paribus*), we found that evasion falls in the peak hour, which is a novel result, and the interpretation is discussed in this

paper. Regarding socioeconomic variables, our results are consistent with prior studies as evasion at bus stops located in higher income zones is significantly lower than in more deprived zones. We identified three main methods to address evasion; (i) improving the operations and design of the system; (ii) increasing inspections and enforcement of penalties (i.e. in “pay zones” average evasion decreases by 63.76%) and (iii) changing the public perception of the system and the social reasons for evading.

Finally, we view fare evasion as more complicated than passengers simply acting as rational actors who attempt to maximize utility. In order to address evasion it is necessary to examine the social and transit system contexts in which fare evasion takes place. Our results consistently indicate that operational factors, like overcrowding, can heavily impact evasion. However, it is also necessary to recognize the importance of psychosocial factors, especially those related to group processes. When people are in collective contexts, they may experience *deindividuation*, which leads them to adopt ‘group norms’, increasing their susceptibility to social influence. Under these conditions, people tend to replace their individual standards for the group or groups’, increasing the imitation of others and experiencing ‘social contagion’ (Hatfield *et al.*, 1994). The perception that others are evading may increase evasion.

Our findings are consistent with the social psychology theory. The individuation process can explain the increase in the rate of evasion as more people get on the bus. Entering by the back door provides anonymity to the evaders, and our results indicate that the average value of evasion decreased by 72.7% compared to the situation in the back door. These findings motivate us to extend the research scope to examine evasion from both the engineering and psychology perspectives and factor in more international experience. We hope that these results will generate an impact on public policy discussions currently under debate, and add to the literature about evasion.

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