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A new approach to predict the market and impacts of round-trip and point-to-point carsharing systems: Case study of London

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ABSTRACT

There are nearly two million subscribers to carsharing services worldwide. These services can provide large benefits both to users and the general public (e.g., through emissions reductions). There has not however previously existed a general framework for forecasting their market potential and impacts that is sensitive to the way that they re-structure the costs associated with personal car ownership. Techniques for predicting market scope and impacts ahead of field implementation are urgently required, both by entrepreneurs and the public sector, whose support, or at least acquiescence, is generally required.

This paper draws on the *Perceived Activity Set* conceptual framework that was recently developed to address the methodological challenges posed by carsharing, and presents the first set of empirical findings from employing it to model carsharing. The empirical analysis makes uses of pooled data from the British National Travel Survey and a purpose-designed stated-choice survey. We investigate both the 'round-trip' and 'point-to-point' carsharing service models.

The results suggest that the number of prospective subscribers to a point-to-point carsharing service in London is between three and four times as large as the comparable number for round-trip carsharing. The greatest reduction in overall vehicle-miles of travel – including both carsharing cars and private cars – was found from introducing round-trip carsharing across all of London. Survey respondents indicated they would use point-to-point carsharing for commuting journeys much more frequently than round-trip carsharing. Finally, point-to-point carsharing was found to be a substitute for public transport, whilst round-trip carsharing was found to be a complement.

Introduction

Carsharing (CS) is a form of short-term car access made practical by the confluence of falling prices for the necessary information technologies, forward-looking entrepreneurs, and policy support from the public sector. CS systems began

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emerging at commercial scale in the mid-1990s, though experiments with small-scale demonstration projects took place as early as the 1940s (Harms and Truffer, 1998). At the time of writing the number of CS subscribers globally is reported to be well over a million (Shaheen and Cohen, 2013a).

Two important sets of research questions regarding CS are (1) what is the size of the potential market for various types of CS services?, and (2) what are the knock-on effects on usage of other forms of transport?

This paper addresses these questions by drawing on techniques developed by the authors as part of a multi-year study investigating the methodological challenges posed by CS. It is the last of the series arising from this line of enquiry; earlier papers have presented: qualitative research (Le Vine et al., 2009), a novel strategic/tactical stated-choice survey instrument (Le Vine et al., 2011), a method for empirically-constrained efficient survey design (Le Vine et al., 2013a), and a framework for modelling carsharing behavior based on a concept of accessibility termed the *Perceived Activity Set* (PAS) (Le Vine et al., 2013b).

We present here the first empirical results from employing the PAS framework to investigate carsharing. The method is sensitive to CS' distinctive combination of fixed and marginal (usage) costs, as well as its complex pattern of substitution/complementarity with other forms of transport. The latter issue is particularly relevant to calculating CS' sustainability benefits: some users increase their car travel when they subscribe to a CS service, others decrease theirs, and these two effects must be netted against each other to identify the overall impact on car use and emissions (Martin and Shaheen, 2010). Subscribers tend to use CS infrequently, much less often than car owners drive privately-owned cars, and the PAS-based technique involving trade-offs between fixed and marginal costs is particularly suitable for analyzing this aspect of CS.

The empirical analysis in this paper examines two forms of CS systems – the 'round-trip' business model, and the more recently-emerging 'point-to-point' business model. In this paper we consider centrally-owned fleets, as opposed to peer-to-peer CS services (Chen et al., 2014; Clark et al., 2014).

Round-trip CS describes systems in which the user must return the CS vehicle to its starting point at the end of their usage episode (Shaheen and Cohen, 2013a). The episode thus includes both the travel to and from a destination(s) and the time spent whilst there. Paying during the time spent at an activity is analogous to time-based parking charges. Advance reservations are required, though at times of low utilization it can be possible to find an available vehicle on short notice. In certain instances, round-trip CS services are designed to serve specific market segments such as university campuses.

Point-to-point CS services do not require the customer to return a CS car to the same place it was taken from (Firnkorn, 2012). There are exceptions, though in most cases usage in point-to-point CS systems is spontaneous, without an advance reservation. In comparison to round-trip CS, the user thus has more flexibility over when and for how long they use a CS car, but at the expense of a lower degree of assuredness that a car will be available when desired. The user pays by the minute whilst they are traveling, and may be able to pay a reduced rate whilst parked at a destination if they wish to continue their exclusive access to the vehicle. In some cases cars can be picked up and dropped off only at fixed stations, whereas in other systems the vehicles can be kept in [nearly] any legal on-street parking space.

The empirical setting for this study is Greater London, England. Two datasets (one revealed-choice, the other stated-choice) with complementary properties are pooled to draw on their representative strengths. The sample sizes are modest, however, particularly for the stated-choice survey (n = 704 respondents from 300 households in the revealed-choice dataset; n = 72 respondents, each performing 4 repetitions of the choice task in the stated-choice dataset). The modest stated-choice sample size is due to the relatively high unit cost (£69/respondent), as the interview was more complex and longer in duration than typical stated-choice surveys, and required administration with an interviewer present. Therefore, despite reweighting the data to match London's car ownership and CS-subscription levels, the estimates of market size and impacts must be viewed as indicative-only. These are however the first empirical results arising from the use of this class of techniques to analyse carsharing, and an important item for the future research agenda is to implement these methods with larger-scale, nationally-representative datasets.

The remainder of this paper is structured as follows. Background discusses earlier methods to analyse the CS market and its impacts. Methods and data introduces the analytical methods and empirical data used in this study. The following sectoin presents the study's results, and Conclusions summarises the paper.

Background

CS represents a very different form of access to car-borne mobility than private car ownership. Buying a car requires relatively large fixed costs (purchase, insurance, maintenance, etc.), as well as securing parking for it. Any fixed costs to subscribe to a CS service are much lower, but the usage costs of driving a CS car are in general substantially higher than operating a personal car. The subscriber also has less control over their access to use a car when and where they wish than they would with a personal car that they own. A person may of course also choose to neither purchase a car nor subscribe to a CS service; they incur no fixed costs from either car ownership or CS subscription, but are limited to much less flexible and reliable options if they wish to access a car. Each of these three states (car ownership, CS subscription, neither) therefore represent different bundles of fixed and per-usage costs and mobility characteristics.

The CS market has important public policy implications. In addition to the possibility of helping to deliver emissions reductions from the transport sector, other possible benefits include increased active travel (i.e., walking and cycling) and reduced parking needs for privately-owned cars. Conversely, vehicles in a CS fleet themselves require parking; the net impact