Development of joint models for channel, store, and travel mode choice: Grocery shopping in London

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A B S T R A C T

The nature of shopping activity is changing in response to innovation in retailing and the growth in online channels. There is a growing interest from transport researchers, policy makers, marketing and retail businesses in understanding the implications of this change. However, existing tools and techniques developed for analysing behaviour in traditional retail environments do not adequately represent emerging complexities resulting from digital innovation. In this paper, we advance existing destination and mode choice models by incorporating online channels in a unified framework. This is a critical extension to existing transport literature on destination choice which largely ignores online activity. Specifically, we develop discrete choice models using elemental store (including both online and in-store) alternatives for joint choice of channel, store, and travel mode. We demonstrate the use of a widely-accepted consumer panel dataset with minor modifications, for the first time in transport research, together with API based data mining tools that offer great potential for enrichment.

The analysis focuses on grocery shopping and uses consumer data collected from two selected boroughs in London; results from multinomial logit and nested logit estimations are reported. The extension presented here provides the tools to quantify the effects of increased online shopping on traditional store formats and travel patterns. Our results showed virtual alternatives currently offer an attractive substitute among early adopters for large basket shopping mostly for high income groups. This might suggest a significant reduction in shopping trips to hypermarkets often associated with large basket shopping potentially leading to store closures. Online deliveries mostly draw from driving trips and less so from walking and public transport trips. The present study also confirmed previous findings related to smaller stores and longer travel distances being associated with declining utilities, agglomeration and competition significantly influencing store choice.

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1. Introduction

The online retailing market has been growing steadily over the past decade and continued growth is expected. The share of online retailing in the UK, as a percentage of all sales, reached 12.5% in 2015 compared to only 0.3% in 1998 and 2.1% in 2002 (Office for National Statistics, 2015). In the USA e-commerce retail sales accounted for 7% of all sales in 2015, up from 2.8% in 2006 (Bucchioni et al., 2015). There is a growing interest from transport and town planning professionals, policy makers, as well as marketing and retail businesses in understanding how shopping behaviour is changing and potential

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implications for the future. These changes in the nature of retailing activity have implications for travel in general and more specifically for personal mobility. There is an extensive literature in transport research that looks at potential implications of increasing use of information and communication technologies (ICTs), as detailed in Section 2 of this paper. Further research, however, is needed for developing the modelling tools and identifying data requirements for studying choice behaviour in this increasingly complex retail environment. One area of particular interest is the analysis of choice behaviour involved in shopping when shoppers choose from a variety of in-store and online alternatives as well as delivery and travel options available to them. The modelling of this behaviour is valuable both from a research perspective due to the complexity of the choice process, and also from a business and policy perspective for providing insights into the potential implications of shifts in the retail market.

Existing models used by transport planners have very little representation of the complexity involved in multi-channel shopping. Shopping destination and travel mode choice models in transport research focus on spatial choice behaviour and exclude online alternatives. The literature on channel choice, on the other hand, has largely focused on modelling the choice between online and in-store alternatives ignoring the heterogeneity within each channel and linked choice dimensions resulting in trip generation. In this paper, we bridge this gap by developing discrete choice models for joint choice of channel, shopping destination (store), and travel mode. The retail sector in the UK offers an opportunity for studying channel choice due to its relatively developed online market (Centre for Retail Research, 2016). Still, finding empirical data sources for this line of work presents a challenge as travel surveys do not adequately capture online activity. Here, we also demonstrate the use of an existing and widely-accepted consumer panel data with a modest augmentation in a novel context to address this data gap. Collating and merging data from multiple additional sources for enrichment of panel data were also required.

The literature emphasizes the importance of acknowledging shopping itself is a heterogeneous class of activities when modelling behaviour (Mokhtarian, 2004; Visser and Lanzendorf, 2004; Rotem-Mindali and Salomon, 2007; Girard et al., 2003). Shopping for daily groceries may involve different behavioural mechanisms with different mobility implications when compared to occasional shopping for white goods items. Changes in retailing are also likely to impinge on the problem of channel and mode choice very differently in different retail sectors (e.g., electronics, clothing, furniture). While it might be of interest in principle to investigate these differences, a comprehensive treatment is beyond the scope of this study. We limit our focus to grocery shopping occasions where a transaction occurs (i.e., excluding pre- and post-purchase trips). The reasons for this decision was fourfold. First, grocery shopping is the most common and frequent type of shopping, which makes it more relevant for travel implications and data collection less challenging. In Britain, food shopping was the most popular purpose accounting for half of all shopping trips and car was the main mode of transport for 78% of these journeys in 2014 (DfT, 2016). Average distances for food shopping trips were lower at 3.6 miles when compared to all shopping trips at 4.9 miles (DfT, 2016). Second, online grocery market is a very dynamic and fast growing segment at present and is expected to grow with an annual growth rate of more than 50% over the next five years in the UK (Gladding, 2016). Only within the past year Amazon Fresh expanded to the UK (Butler, 2016) and big players such as Google Express and Uber entered online grocery market (Thielman, 2016; Whipp, 2016). Hence, potential implications on travel will be increasingly important. Third, shopping is increasingly seen as leisure activity introducing additional complexity when modelling the choice between online and in-store. Grocery shopping is among the most utilitarian with minimal (if any) recreational value. In our view, this allows to really get at the physical vs. virtual issue net of any of the complicating factors relating to recreational value of shopping. Fourth, pre-purchase (searching) and post-purchase (returns) stages are less relevant for additional trip generation reducing the complexity involved in modelling.

The remainder of this paper is organised as follows. In the next section, we present a brief review of previous work on online shopping and store choice behaviour. The third section describes the data used in this analysis, while the fourth section looks at methodology and model specification. The fifth section presents the results of model estimation. Finally section six summarises the findings of this research.

2. Previous work

Shopping has been subject to transport research as it has been one of the most popular reasons for travelling since the 1970s. In 2014, for instance, shopping was the most common trip purpose accounting for 19% of all trips in England (DfT, 2015). Shopping related travel is driven by the dynamics of the retail sector and hence highly influenced by its transformation. For example, average distances travelled for shopping trips have increased significantly in the UK over the past 20 years with out of town retail developments (DfT, 2015). Changes in retailing driven by ICT innovation is another important example of this, which have not really been extensively explored from a choice behaviour perspective. Transport researchers have been interested in understanding potential travel implications of increasing use of ICTs since the 1980s, with a focus on assessing its potential for reducing demand. At a conceptual level, potential travel impacts of increasing use of ICT have been classified into four types: substitution, complementarity, modification, and neutrality (Salomon, 1985, 1986; Mokhtarian, 2003; Hjorthol, 2002; Mokhtarian et al., 2006; Mokhtarian, 2009). More specifically, many studies in transport literature focus on quantifying the net effects of increased use of ICT on shopping journey frequency and miles travelled with a range of, sometimes contradictory findings as evidenced in comprehensive reviews by Weltevreden (2007), Bhat et al. (2003), Rotem-Mindali and Weltevreden (2013), and Rotem-Mindali (2014). The relationship between frequencies of in-store and