# Explore the relationship between online shopping and shopping trips: An analysis with the 2009 NHTS data

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Yiwei Zhou [a,1], Xiaokun (Cara) Wang [b,*]

[a] Department of Civil and Environmental Engineering, 4027 JEC Building, Rensselaer Polytechnic Institute, 110 8th Street, Troy, NY 12180-3590, USA
[b] Department of Civil and Environmental Engineering, 4032 JEC Building, Rensselaer Polytechnic Institute, 110 8th Street, Troy, NY 12180-3590, USA

ABSTRACT

The rapid growth of ecommerce brings great changes to the transportation system. However, most existing studies focus on the impact of ecommerce on freight system. Its impact on personal trips is relatively less studied. It is reasonable to argue that online shopping reduces the need of shopping trips by making goods accessible via door-to-door deliveries. On the other hand, online shopping may also create more shopping trips as online shoppers travel to stores to experience, compare or pick up the goods. Understanding the connections between online shopping and shopping trips is critical for transportation planners to prepare for changes that information technology will continue to bring to this nation in the future. Using the 2009 National Household Travel Survey (NHTS) data and a structural equation model (SEM), this paper disentangles the bidirectional connections between online shopping and shopping trips. Results show that online shopping encourages shopping trips while shopping trips tend to suppress the online shopping propensity. Besides, both online shopping and shopping trips are influenced by exogenous factors such as shoppers' demographic features, regional specific factors and household attributes. A closer examination at the state level further confirms model validity while disclosing spatial variation in their relationship.

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## 1. Introduction

The advance of information and communication technology has profoundly changed people's way of life. With the widespread use of internet, more and more people choose to shop online. Online shopping, or more often categorized as e-commerce, has been increasing dramatically during the past decade. In the U.S., total e-commerce sales in 2012 reached about $225.5 million, an increase of 15.8% compared to 2011. It took up 5.2% of total sales and the percentage continues to increase (Census, 2013).

The rapid growth of online shopping has brought great changes to the transportation system. As summarized by Mokhtarian (2004), the potential impacts of online shopping include changes in shopping mode share, changes in the volume of goods purchased, changes in per capita consumption spending, and demographic changes. From the perspective of planners and policy makers, these changes imply impacts on economy, population, land use, freight transportation and passenger transportation. As one can expect, online shopping changes freight trip pattern to and from businesses, creates freight trips

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to residential areas, and influences residents' shopping trips. This paper focuses on the last aspect and examines the relationship between online shopping and personal shopping trips.

There has been a long-lasting debate on the impact of online shopping on shopping trips, whether being substitution or complement (Aguiléra et al., 2012). One hypothesis proposed by some of these studies is that online shopping serves as a substitute of shopping trips because there is no need for people to make the actual shopping trips when they can shop online. For instance, Sim and Koi (2002) found that 12% of online buyers reduced their trips to stores based on a survey on 1500 local consumers in Singapore. Tonn and Hemrick (2004) conducted a web survey among residents in Tennessee. Results showed that about 40% of residents reported less driving with the use of internet. Weltevreden and Rietbergen (2007) studied the impact of e-shopping on in-store shopping based on data of 3074 internet users in the Netherlands. Results indicated that more than 20% online buyers made fewer trips to city center stores.

An alternative hypothesis is that online shopping complements personal shopping trips: As people are able to freely browse and choose among numerous products, their desire of shopping may be stimulated, leading to more shopping trips. Choo et al. (2008) analyzed relations between transportation and communications based on the U.S. Consumer Expenditure 1984–2002. Results indicated that both substitute and complementary effects existed, but the impact of communications on transportation was dominantly complementary. Cao et al. (2012) studied relationship between online searching frequency, online buying frequency and in-store shopping frequency using data of 539 adults from a shopping survey in Minneapolis-St Paul metropolitan area and found that online shopping tended to have a complementary effect on in-store shopping.

There are also studies suggesting neutral effect of online shopping on shopping trips. The e-commerce had only a modest impact on consumer travel patterns as moderated by other exogenous factors (Calderwood and Freathy, 2014). In general, depending on survey samples, conclusions on the relationship between online shopping and shopping trips differ significantly. It can be substitute, complement, or neutral.

A few studies tried to explore such inconsistency by examining the spatial variation of the shopping behavior. For example, using a sample of 740 adults from Seattle, Kansas City and Pittsburgh, Krizek et al. (2005) found that people living in suburbs or away from central business district (CBD) were more likely to make online shopping, but the effects are insignificant. Farag et al. (2006) studied shopping behavior of 2190 individuals in the Netherlands. Results suggested that "people are more likely to adopt e-shopping when their accessibility to shops is relatively low".

## 2. Methodology

In terms of methodology investigating the relationship between online shopping and shopping trips, various methods can be used depending on the characteristics of available data. Among them, the most widely adopted approaches are path analysis, binary logit model, multinomial logit (MNL), joint decision models and structural equation modeling (SEM).

Unlike traditional regression models, SEM allows reciprocal influence among variables. In fact, as stated by Pearl (2013), linear SEM serves as a "microscope" for causal analysis. It helps quantify the causal assumptions in the model and assess the impact of a particular phenomenon. Another advantage of SEM is that the framework accommodates the use of latent variables, which can be used to conveniently incorporate unobservable variables such as attitude into the model. SEM is widely used in many fields such as agriculture, meteorology, economy, psychology, sociology and engineering. Farag et al. (2007) studied the interactions between online searching frequency, online shopping and shopping trips using SEM. In addition to disclosing a complementary effect between online shopping and shopping trips, the study also found that urban residents shopped online more frequently than suburban residents. Cao et al. (2012) used SEM to examine the relationship between online searching frequency, online buying frequency and in-store shopping frequency. Positive mutual influence between each pair of the dependent variables was identified. Household income, age, education, and working status were also found significantly influential to individual shopping behavior. Existing methods to study impacts of online shopping are summarized in Table 1.

**Table 1**
Existing methods summary.

| Literatures | Methods | Key variables | Conclusions |
|---|---|---|---|
| Farag et al. (2005) | Path analysis | Socio-demographic, land use, behavioral, and attitudinal variables | Complementary effect between online shopping and shopping trips |
| Ren and Kwan (2009) | Binary logit | Travel pattern, internet diary and accessibility data | People with low accessibility to local shopping and white people are more likely to adapt to online shopping |
| Weltevreden and Rietbergen (2007) | MNL | Shopping enjoyment, internet access, education, accessibility and travel mode | Complementary effects in short run but substitution in long run |
| Ferrell (2005) | SEM | Time use variables of work, maintenance and shopping activities | Small substitution effect of online shopping on shopping trips |
| Ferrell (2004) | 2SLS | Time use variables and trip activity data | Complementary effect of online shopping on shopping trips |
| Cao et al. (2012) | SEM | Shopping and internet use frequency, social-demographics | Complementary effect of online shopping on shopping trips |
| Farag et al. (2007) | SEM | Life style, shopping attitudes, land use, shopping behavior | Complementary effect of online shopping on shopping trips |