



# Bicycle commuting market analysis using attitudinal market segmentation approach



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## ABSTRACT

The market segmentation analysis for bicycle commuting can help identify distinct bicycle market segments and develop specific policies or strategies for increasing the bicycle usage in each segment. This study aims to use the approach of attitudinal market segmentation for identifying the potential markets of bicycle commuting. To achieve the research objective, the household survey is conducted to obtain the travelers' attitudes towards their commuting travels. The factor analysis is used to explore the latent attitudes. The structural equation modeling (SEM) simultaneously estimates the correlations between the attitudinal factors. The *K*-means clustering is conducted to segment the bicycle commuting market into several submarkets. Finally, six segments of bicycle commuting market with distinct attitudes are identified by four dividing factors including the willingness to use bicycle, need for fixed schedule, desire for comfort, and environmental awareness. The attitudinal characteristics, socioeconomic features, and actual bicycle choices in each market segment are analyzed and compared. The policy implications that best serve the needs of each submarket are discussed to promote the bicycle commuting.

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## 1. Introduction

Bicycle has been widely recognized as an environmentally friendly mode of transport. Numerous studies have been conducted to explore how to increase the bicycle usage for commuting trips (Martens, 2004; Meeusen et al., 2008; Pucher and Buehler, 2008; Su et al., 2010; Xing et al., 2010; Yang et al., 2010; Pucher and Buehler, 2011; Heinen et al., 2011). Previously, most bicycle-related policies generally focused on the whole population of travelers. However, heterogeneous travelers could respond differently towards policies which sometimes makes the results of these policies be less effective. The market segmentation approach is helpful in distinguishing the bicycle commuting markets with distinct characteristics. More focused policies and strategies that best serve the needs of each submarket can be developed to promote the bicycle commuting. The effectiveness of these policies can be estimated more accurately.

The market segmentations traditionally used in the bicycle-related studies are commonly based on some intuitive socioeconomic characteristics, such as gender, age or income, or attribute of trips, such as trip length or purpose. But these segmentation methods fail to explain why individuals with similar socioeconomic or trip features make different decisions

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on the choice of bicycle for travels. In particular, inconsistent conclusions on the relationships between the bicycle usage and these factors are often found in different surveys (Pucher et al., 2009; Heinen et al., 2010) which indicates these relationships may not be well explored or understood. In recent years, the interest of using travelers' attitudes for the market segmentation analysis has drawn more attentions from transportation researchers. Studies have shown that the attitude-based market segmentation is useful in identifying potential transit markets and developing plans to increase the public transport ridership (Outwater et al., 2003; Shifan et al., 2008). These studies motivate our thought of using the attitude-based segmentation for the bicycle commuting market analysis.

The primary objective of this study is to use the attitudinal market segmentation approach for identifying the potential submarkets of bicycle commuting. More specifically, this study includes the following tasks: (1) to identify the travelers' latent attitudes towards commuting travels and estimate the relationships between them; (2) to segment the bicycle commuting market into several distinct segments based on the attitudinal factors; and (3) to analyze the characteristics of these submarkets and develop policies to promote the bicycle usage in each segment. The findings of this study can help identify the travelers who could be persuaded to be bicycle commuters and those who might be enticed out of bicycle commuting.

The remainder of this paper is organized as follows. The following section reviews the existing work. Section 3 introduces the methodology for the market segmentation analysis. Section 4 gives the model estimation results and Section 5 discusses the findings and policy makings. The paper ends with concluding remarks and future work in Section 6.

## 2. Literature review

Previously, the market segmentation has been used in the studies on travel behaviors (Badoe and Miller, 1998; Button and Hensher, 2001; Cambridge Systematics, 2001; Outwater et al., 2003; Elgar and Bekhor, 2004; Ryley, 2006). Travelers or travel activities with distinct characteristics can be identified as different submarkets. Previous studies have shown that the market segmentation analysis is a means of increasing the share of public transit modes. For example, a hand-book published by TRB provided detailed steps and procedures for implementing the market-segmentation plans to increase the transit use (Elmore, 1998). The market segmentation has also been found useful in developing strategies to best serve the various submarkets for increasing the public transport ridership (Guliano and Hayden, 2005; Shifan et al., 2008).

Some simple and basic ideas on the market segmentation have been found in several bicycle-related studies. Deakin (1985) defined the potential bicycle commuting market as employed full-time, under 40 years old, travels less than 11.2 km one-way to work, drives alone during peak-period, and owns a bike suitable for commuting, and estimated the reasonably upper bound on the size of the market. Clark (1997) grouped the existing trips into several segments based on the trip length and trip purpose and estimated the potential transferring vehicle trips to bicycling and walking. Bergstrom and Magnusson (2003) clustered the bicycle travelers into winter cyclist, summer-only cyclist, infrequent cyclist, and never cyclist, and evaluated the number of bicycle trips potentially transferred to car trips in a winter season. Shan (2007) segmented travelers into several groups by the commuting trip length and developed separate mode choice model for each group. Xing et al. (2010) grouped the bicycle trips into bicycling for transportation and recreation by the trip purpose and identified the factors associated with the miles of bicycling in each group. Heinen et al. (2011) segmented the commuting trips into three groups according to the trip length (<5 km, 5–10 km, and >10 km) and identified the attitudes related to the choice to cycle to work.

The above studies generally segment the bicycle travelers or trips based on some pre-defined socioeconomic characteristics or trip attributes. But these segmentation analyses do not consider the fact that individuals with similar socioeconomic or activity characteristics could make different decisions on the bicycle choice. In recent years, there has been an increasing interest in using the travelers' attitudes for the market segmentation analysis. This method is supported by significant works which have shown that the attitudinal factors are important in the mode choice sometimes even more than the instrumental variables (Steg et al., 2001; Anable and Gatersleben, 2005; Steg, 2005; Abraham and Gardner, 2007; Heinen et al., 2011).

Anable (2005) segmented the travel market based on multi-dimensional attitudinal statements to identify the degrees of mode switching potential. This study also indicated that the common segmentation method based on the socioeconomic variables or simple behavioral measures could oversimplify the structure of the market. Outwater et al. (2003) segmented the ferry-riding market into eight subsegments by three attitudinal factors which were the travelers' reaction to time saving, sensitivity to travel stress and desire to help environment. Shifan et al. (2008) used the market segmentation approach to identify the potential transit markets. Travelers were clustered into eight groups by three attitudinal factors including the sensitivity to time, need for fixed schedule, and willingness to use public transit. Specific plans were developed to increase the transit ridership in each submarket.

The relationship between travelers' attitude and bicycle choice was reported in several previous studies. Davies et al. (1997) confirmed the significant impact of attitudinal factors on the willingness of bicycling. The attitude towards safety and convenience of bicycling was found significantly influenced the bicycle use (Noland and Kunreuther, 1995). A positive attitude towards bicycling increased the likelihood of bicycle commuting (Dill and Voros, 2007) while a negative perception towards car use simulated the bicycling (Stinson and Bhat, 2005). Gatersleben and Appleton (2007) examined the attitudes and perceptions in relation to the bicycling to work and found that the attitudes towards bicycling and the perception of barrier influenced travelers' decision on bicycle use. A recent study by Heinen et al. (2011) reported that the attitudes including the awareness, direct trip-based benefits and safety had relatively strong impacts on the choice to commute by bicycle.

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