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Investigating the impact of satisfaction indicators on the efficiency of choice models: New evidence from Lebanon

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ABSTRACT

New approaches to choice modeling which aim at increasing model realism through increased model complexity to capture different aspects of human behavior and latent psychological constructs have been increasingly applied in recent transportation research efforts. One of the most recent approaches is the inclusion of happiness or satisfaction indicators which function as measures of utility. In previous work using revealed preference data, adding satisfaction indicators resulted in gains in efficiency.

This paper explores whether gains in efficiency also hold in a stated preference context of mode choice where the data is more controlled and the satisfaction that is measured includes both satisfaction with a usual commuting mode and expected satisfaction for a non-routine commuting mode. The paper also tests whether gains in efficiency lead to any improvements in prediction accuracy. Finally, the paper also presents a scenario analysis for the prediction of changes in satisfaction as a function of changes in car and bus attributes.

The results indicate that the addition of satisfaction indicators to the model indeed improve model efficiency in line with other findings from previous research utilizing the same framework. Such findings encourage choice modelers to collect satisfaction indicators in revealed and stated preferences surveys and to subsequently include these indicators in choice models to increase model efficiency. However, the gains in efficiency do not lead to improvements in prediction in the study context probably due to the controlled nature of the stated preference data.

1. Introduction

With increasing computational power and advances in discrete choice research, choice models are being continuously extended in various ways in order to better mimic real-life decisions. One such active area of extension, for instance, is the recent development of hybrid choice models (HCM's). Another recent extension is the addition of measures of happiness or other subjective indicators such as expectations to choice models (Delavande, 2008; Manski, 2004).

While of recent interest to choice modelers, happiness has been of interest to philosophers since as early as the Ancient Greeks and remains of great interest nowadays to philosophers, policy makers, governments and others (Leslie et al., 2010). During the last

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century, this preoccupation with happiness spawned a number of research endeavors that looked into the accommodation of subjective measures in the study of social indicators (Duarte et al., 2010).

In the field of transportation, several studies on happiness, satisfaction, or more generally subjective well-being have surfaced over the past few years. Such studies look into how well-being is linked to various aspects of transportation, such as linkages between transportation resources and overall well-being (Delbosc, 2012; Ettema et al., 2010), satisfaction with different modes of travel (Morris and Guerra, 2015; Smith, 2013) and the link between activity pattern and well-being (Jakobsson Bergstad et al., 2012). De Vos et al. (2013) provide a comprehensive survey of recent studies treating subjective well-being in the transportation field.

Similarly, the incorporation of satisfaction measures into transport mode choice models has been recently undertaken (Abou-Zeid and Ben-Akiva, 2010) in attempts to extend random utility models so as to improve model efficiency. This entails the addition of satisfaction measurement equations, whereby satisfaction measures act as indicators of random utility in addition to the usual choice indicators. An application of this extended random utility model to a transportation mode choice context was shown to improve the efficiency of the parameter estimates in the utility equation (Abou-Zeid and Ben-Akiva, 2013). In the latter study, satisfaction indicators were collected at the time of the mode choice decision through an experimental setup where car commuters in Boston had to decide whether to switch to public transportation or keep commuting by car. A conceptual framework to include such satisfaction indicators in activity-based models was also proposed in Abou-Zeid and Ben-Akiva (2012), while an application to activity pattern choice modeling was undertaken by Carrion et al. (2015) and shown to result in greater model efficiency as well.

This paper seeks to provide further support to the nascent body of literature investigating the impact of including satisfaction indicators on model efficiency, whereby to the authors' knowledge there are only two similar previous applications in the literature cited above which used revealed preference data. The paper studies the impact of such indicators in terms of efficiency, prediction accuracy, and scenario analysis in a discrete mode choice model using data from a stated preference (SP) survey on upgrading bus services in the Greater Beirut Area, Lebanon. Moreover, differently from previous studies, this paper uses two types of satisfaction measures: satisfaction with the current commute by car and expected satisfaction with a non-routine commuting mode, the bus. The results of the study may encourage researchers to use satisfaction indicators more often in their modeling efforts and planners to collect satisfaction data in their surveys. The modeling framework is general and applies to any choice context (transportation or other) where satisfaction indicators are available in addition to the choice.

The paper is organized as follows. Following this introduction, a general modeling framework for discrete choice models including satisfaction indicators is presented. The third section describes the data used in this study and previous applications in which the data has been used. Afterwards, the mode switching model established in this study is presented in detail. Model estimation results are presented in the fifth section. The sixth section presents the tests of model efficiency. The seventh section conducts prediction analysis, and the eighth section concludes the paper.

2. General modeling framework

In the subjective well-being literature, there is differentiation between cognitive and affective components of well-being. The cognitive component refers to overall evaluation/judgement of an experience or of life while the affective component is an expression of one's feelings and moods. Moreover, one can tap these notions of well-being with life as a whole or with specific domains of life. In this paper, we focus on satisfaction (which is a cognitive component of subjective well-being) in the transportation domain, and particularly satisfaction with commuting with car and bus.

Moreover, the subjective well-being literature distinguishes among different notions of well-being according to the time scale at which they are measured. In particular, Kahneman et al. (1997) and Kahneman (2000) refer to remembered utility, moment or real-time utility, decision utility, and predicted utility. Remembered and moment utility are forms of experienced utility, where remembered utility refers to a retrospective evaluation of experiences while moment utility refers to instantaneous recordings of hedonic experience. Decision utility is that associated with choices in random utility models while predictive utility refers to a

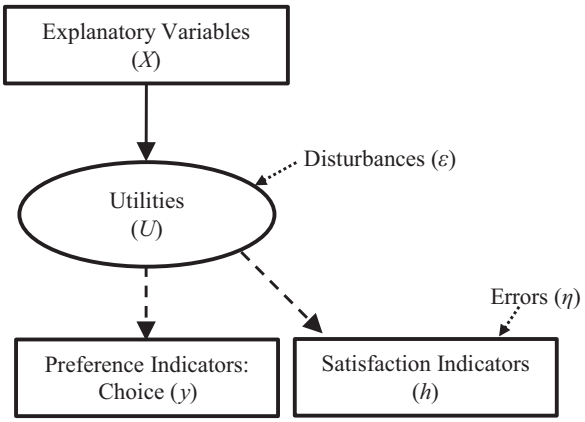

Fig. 1. Discrete choice model framework incorporating satisfaction measurements (Source: Abou-Zeid and Ben-Akiva, 2010, 2012).