Resource and Energy Economics 42 (2015) 71–92

Contents lists available at ScienceDirect

Resource and Energy Economics

journal homepage: www.elsevier.com/locate/ree

The effect of choice set misspecification on welfare measures in random utility models

Lianhua Li [a], Wiktor Adamowicz [b,*], Joffre Swait [c]

[a] School of Business, University of Alberta, Canada
[b] Resource Economics and Environmental Sociology, Faculty of Agricultural, Life & Environmental Sciences, University of Alberta, Edmonton, AB, Canada T6G 2H1
[c] Institute for Choice, University of South Australia, Australia

ARTICLE INFO

Article history:
Received 7 December 2014
Received in revised form 9 June 2015
Accepted 6 July 2015
Available online 14 July 2015

JEL classification:
Q51
C25

Keywords:
Choice model
Choice set formation
Random utility
Welfare measures

ABSTRACT

Random utility models have been widely employed in environmental valuation. But stochastic choice set formation models in the random utility framework are rarely applied in this literature, although previous research has shown that ignoring choice set formation (when it exists) leads to biased parameter estimates and welfare measures. This paper conducts Monte Carlo (MC) experiments to investigate the directionality and magnitude of welfare measure bias arising from ignoring or misspecifying choice set formation. We find that when attribute cutoff-based choice set formation exists in the data generation process, typical RUM models ignoring or misspecifying choice set formation underestimate welfare measures by 30–50%. Models that approximate choice set formation may produce unbiased welfare measures, but constitute a promising area for future research. This paper illustrates the importance of applying choice set formation in environmental valuation and provides practical guidance about the usage of stochastic choice set formation models.

* Corresponding author. Tel.: +1 780 492 4603; fax: +1 780 492 0268.
E-mail addresses: lianhua@ualberta.ca (L. Li), vic.adamowicz@ualberta.ca (W. Adamowicz), Joffre.Swait@unisa.edu.au (J. Swait).

http://dx.doi.org/10.1016/j.reseneeco.2015.07.001
0928-7655/

1. Introduction

Random utility models have been widely employed in environmental valuation to provide welfare measures for changes in attributes of an environmental good. For example, they have been popular in measuring welfare changes affecting recreation demand since the 1990s (e.g., Bockstael et al., 1991; Parsons et al., 2000a,b; von Haefen, 2008) and have seen increasing application in property value analyses (e.g., Chattopadhyay, 2000; Banzhaf and Smith, 2007; Bayer et al., 2009). However, relatively few studies account for choice set formation in random utility models, that is, the effect that an individual may form a "choice set" (also sometimes called "consideration set") from among all available alternatives before starting to evaluate and compare those considered alternatives.

Incorporating choice set formation processes in environmental valuation is theoretically and practically important, because earlier research in the transportation literature has shown that ignoring such effect of choice set formation leads to *biased model parameters* (Swait and Ben-Akiva, 1985, 1987a,b) on the basis of which welfare measures are computed. A few studies (e.g., Peters et al., 1995; Banzhaf and Smith, 2007; von Haefen, 2008) in the environmental economics and property valuation literatures have also shown that choice set formation processes affect welfare measures. However, these studies have not shown conclusively that ignoring choice set formation lead to *biased welfare measures*. Another limitation of these studies is that except for a few examples (e.g., Haab and Hicks, 1997; von Haefen, 2008) choice set formation is predominantly accounted for as a deterministic process (i.e., specific choice sets are imputed as deemed reasonable by researchers) rather than as a stochastic process (i.e., all possible combinations of choice sets are included into a model probabilistically), although choice set formation is better described as the latter process given that the choice set that an individual forms is generally unknown to researchers. This lack of interest in adopting stochastic choice set formation models (which describe choice set formation as a stochastic process) may in part lie in the fact that these models are computationally burdensome especially when the number of alternatives is relatively large. For example, when the number of alternatives is 7, the number of all possible non-empty choice set combinations is 127 ($=2^7-1$), with 12 it is 4095 sets, and so forth.

The main purposes of this paper are, therefore, to investigate (a) whether ignoring choice set formation, misspecifying choice set formation as other processes such as taste heterogeneity,[1] or treating choice set formation as a deterministic process, biases welfare measures; and (b) how to alleviate the computational burden inherent to most stochastic choice set formation models. To achieve these objectives, we conduct Monte Carlo (MC) simulations to generate synthetic data according to a known data generation process (dgp). We purposefully choose to simulate a policy change (a price increase) that can affect both the choice set formation process and the utilities. Specifically, in the adopted dgp alternatives with a price higher than a probabilistically distributed cutoff are excluded from the true choice set. This stochastic price cutoff is analogous to an unobserved spatial limit in a recreational demand model or an unknown budget constraint in a property value model. Then, we calculate the true welfare measures based on the change in the utilities of the chosen alternatives (equivalent to assuming we know the stochastic components in the data generation process). Next, we estimate several models on the simulated data, each model representing a different way of treating choice set formation, and calculate welfare measures based on the model parameters. The above data generation, model estimation and welfare calculation cycle is repeated 200 times per condition to examine the robustness of the results. After comparing the estimated and true welfare measures, we find that not only does ignoring or misspecifying choice set formation as taste heterogeneity bias welfare measures, but so does representing it as a deterministic process when it is stochastic (to the tune of a 30–50% downward bias based on our simulated data). Only by accounting for choice set formation as a stochastic process (i.e., adopting stochastic choice set formation models) can we recover the true welfare measures. We also explore two ways of alleviating the computational burden of the stochastic choice set formation models by creatively utilizing an approximation.

[1] By this we refer to the situation in which a data generation process which includes screening of alternatives (choice set formation) but no preference heterogeneity is misspecified purely as preference heterogeneity, say in the form of a Mixed Logit or Latent Class choice model. This potential confound is, in our opinion, a very common one to be found in applied settings.