Transportation Research Part A 46 (2012) 446–456

Contents lists available at SciVerse ScienceDirect

Transportation Research Part A

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

Demand and welfare effects in recreational travel models: Accounting for substitution between number of trips and days to stay ☆

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ARTICLE INFO

Article history:
Received 17 March 2010
Received in revised form 14 October 2011
Accepted 17 November 2011

Keywords:
Demand analysis
Welfare effects
Count data
Bivariate zero inflation

ABSTRACT

In this paper we present a non-linear demand system for households' joint choice of number of trips and days to spend at a destination. The approach, which facilitates welfare analysis of exogenous policy and price changes, is used empirically to study the effects of an increased CO_2 tax. In particular, we focus on the effect of including substitution between households choice of the number of trips and days to spend at a destination in the welfare analysis. The analysis reveals that the equivalent variation (EV) measure, for the count data demand system, can be seen as an upper bound for the households welfare loss. Approximating the welfare loss by the change in consumer surplus, accounting for the positive effect from longer stays, imposes a lower bound on the households welfare loss. The difference in the estimated loss measures, from the considered CO_2 tax reform, is about 20%. This emphasizes the importance of accounting for substitutions toward longer stays in travel demand policy evaluations.

1. Introduction

In this paper we empirically evaluate and analyze welfare effects and changes in recreational demand due to an increased carbon dioxide tax, which aims to reduce the emissions of CO_2 and other greenhouse gases. In particular, the focus is on studying the importance of including households possible substitution between number of trips and days spent at a destination in welfare analysis. A previous study by Hellström (2006) indicate that households substitute trips for days as travel costs are increased. Ignoring this possible substitution in welfare analysis may overstate households welfare losses due to exogenous policy and price changes. In this paper the economic significance of accounting for this substitution in welfare analysis is empirically evaluated. Thus, the contribution of the paper are of potential importance for policy makers evaluating policy analysis directed towards the recreational travel sector. The modeling approach considered in the paper accommodates for the count data feature of recreational demand, i.e., the number of trips and the number of days stayed, and treats the households' decision of number of trips and number of days to stay as a simultaneous choice. The approach renders a non-linear recreational demand system, which is used to calculate exact as well as approximative welfare measures, including/not including the welfare change due to changes in the length of the trips. The evaluation of demand and welfare effects relating to recreational activity is likely to be important in the future since many countries are committed to reducing the

☆ The financial support of the Swedish Research Council for Environmental, Agricultural Sciences and Spatial Planing, and The Wallander Foundation is gratefully acknowledged. We also would like to thank the editor and two anonymous referees for helpful comments and suggestions on an earlier version of the paper.

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0965-8564/$ - see front matter
doi:10.1016/j.tra.2011.11.001

emissions of CO_2 and other greenhouse gases, at the same time as households' budget shares for recreational services can be assumed to be increasing with rising incomes[1] and more leisure time.

During the commitment period 2008–2012 the Kyoto Protocol state that the overall emissions of greenhouse gases from the developed countries should be at least 5% below 1990 levels. At the time of writing, no new international agreement for reducing greenhouse gases has been signed, although the commitment period is drawing towards an end. However, the EU heads of state and government have agreed to reduce the Union's emissions by 30% by 2020 – provided a new, global climate agreement is reached. If no global agreement is reached, the EU is committed to unilaterally reducing emissions by 20%. Additionally, a few countries have also adopted a more ambitious environmental policy. In Sweden the aim is to reduce the greenhouse gas emissions by 40% by 2020, in comparison with 1990 levels. Some US states (e.g., California, Florida, New Jersey, New York and Pennsylvania) have also adopted an environmental policy that aims to reduce the emissions of carbon dioxide, although the US has not signed any global climate agreement.

In Sweden the transport sector accounts for roughly 40% of the emissions of carbon dioxide. Two-thirds of these emissions derive from passenger transport. Among passenger transports leisure trips account for about one third of all trips in Sweden (SCB, 1996; SIKA, 2002, SIKA, 2007) and about 43% of the total travel length (SIKA, 2002). Thus, roughly 11% of carbon dioxide emissions[2] in Sweden are related to leisure traveling. Overall, it is in the transportation sphere that one can expect to find the greatest potential for emission reductions by households in the future. Higher taxes on passenger transport will not only have welfare implications for the household sector, but will also affect other sectors in the economy, such as the tourism and leisure industry. These effects depend to a large extent on how price sensitive households are, and on the substitutions between the number of trips and days on vacation. Previous studies that have considered welfare measurement in recreational count data demand systems (e.g., Ozuna and Gomez, 1994; Englin et al., 1998; Hilger and Englin, 2009) have not considered duration of stay as an endogenous variable. In this paper, we provide some empirical results concerning different ways of measuring household welfare effects, when the household make simultaneous choice of number of trips and days to stay.

Modern recreational demand modeling usually utilizes some type of count data model to accommodate the integer-valued nature of the household's recreational demand, usually measured in terms of the number of trips. A number of authors have also considered time on site (the number of days/nights) as endogenously determined, e.g., McConnell (1992), Larson (1993), Berman and Kim (1999), Feather and Shaw (1999). In the present paper both of these features are accommodated. A non-linear (Poisson) demand system is specified and used to derive appropriate welfare measures. In contrast to most earlier empirical studies, the paper considers simultaneous estimation of the demand for trips and the (total) days to stay in a count data regression framework. A possible drawback with modeling the total number of days to stay on all trips during a period instead of days to stay for each trip is that the distribution of days over different trips are ignored. The advantage with the chosen approach is, however, that it theoretically renders linear budget constraints (see e.g. Larson, 1993) and that it is straightforward to account for the possible substitution between trips and days.[3] Since the data have an excess amount of zeros (see e.g., Gurmu and Trivedi, 1996), i.e., there is a large probability mass at zero not consistent with most conventional count data distributions (e.g., Poisson, negative binomial), a bivariate zero-inflated Poisson lognormal (BZIPLN) model is introduced.[4] Advantages with the BZIPLN model are that compared to similar hurdle specifications (see Hellström, 2006) the likelihood function is relatively simpler facilitating estimation.[5] In addition count data models with lognormal mixture densities frequently provide better fit to data (Winkelmann, 2004). A further advantage with the chosen specification is that the Poisson lognormal distribution does not constrain the correlation between the two endogenous variables to be positive (as in most other count data models, see for example Munkin and Trivedi, 1999).[6] The paper can be viewed both as input to the evaluation of the effects and costs of Sweden's environmental policy and as input on future policy recommendations.

The outline of the paper is as follows: Section 2 presents the economic framework and introduces the empirical study. In Section 3 the data are presented and discussed. Section 4 discusses the econometric model specification and estimation, and Section 5 presents the empirical results. The concluding section contains a number of final observations.

[1] Results in Falvey and Gemmell (1996), Melenberg and Van Soest (1996), Brännlund et al. (2007), Ghalwask (2008) show that the income elasticity of demand for recreational services is larger than one. Ghalwask (2008) also find that the income elasticity for recreational services has increased during the twentieth century.

[2] The emissions of CO_2 related to domestic transportation in 1996 is estimated to 18,835,000 ton, where roughly 5,023,000 ton derive from household leisure traveling. As reference, the similar figures in 2009 were estimated to 20,160,000 ton and 5,376,000 ton, respectively. Figures are taken from Sweden's National Inventory Report 2011, submitted under the United Nations Framework Convention on Climate Change.

[3] An alternative would be to model the number of trips of different durations, e.g. number of one-day trips, two-days trips and so on, in a system of non-linear (count data) equations. It would, however, be less straightforward and econometrically more complicated than the chosen approach.

[4] The bivariate zero-inflated negative binomial model was studied by Wang (2003).

[5] The model specified in Hellström (2006) also include restrictions on the joint distribution of trips and days not imposed in the current model, e.g. the number of days is always larger or equal to the number of trips due to the data definitions (a trip always include at least one day). Preliminary estimation results for the current data did, however, show little difference between the model in this paper and the more elaborate model in Hellström (2006). Due to this, the simpler approach of neglecting the above restriction was chosen in this paper.

[6] Shonkwiler and Harris (1996) was the first to apply the lognormal Poisson model to an economic problem.