Transportation Research Part A 85 (2016) 123–134

Contents lists available at ScienceDirect

Transportation Research Part A

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

The residential parking rent price elasticity of car ownership in Japan

Hajime Seya [a,*], Kumiko Nakamichi [c,b], Yoshiki Yamagata [b]

[a] Graduate School for International Development and Cooperation, Hiroshima University, 1-5-1, Kagamiyama, Higashi-hiroshima, Hiroshima 739-8529, Japan
[b] Center for Global Environmental Research, National Institute for Environmental Studies, 16-2, Onogawa, Tsukuba, Ibaraki 305-8506, Japan
[c] Graduate School of Science and Engineering, Tokyo Institute of Technology, 2-12-1-I4-5, O-okayama, Meguro, Tokyo 152-8550, Japan

ARTICLE INFO

Article history:
Received 4 October 2014
Received in revised form 2 January 2016
Accepted 5 January 2016
Available online 27 January 2016

Keywords:
Residential parking rent price
Car ownership
Elasticity
IV-ordered probit model
Micro data
Japan

ABSTRACT

By using household-level micro data captured through the National Survey of Family Income and Expenditure for 2004, this study evaluates the residential parking rent price elasticity of car ownership in Japan. It analyzes the number of cars owned by a household, using various attributes including expenditure for renting a parking space on a monthly basis. The estimation results derived from the IV-ordered probit model show that the absolute value of parking rent price elasticity of car ownership is, at most, 0.48, which is fairly small (i.e., inelastic). The elasticity value varies depending on city size; for megacities, elasticity is always negative for car ownership, whereas for middle-sized or small cities, towns, and villages, elasticity is positive for one-car ownership and negative for the ownership of more than one car. Hence, when the price of parking increases, some people may switch from more than one car to one car and some people in megacities may switch from one to zero cars. Indeed, the net effect of a price increase may be that non-car ownership increases in megacities and one-car ownership increases in other cities.

1. Introduction

Parking price management (PPM) is an important factor in transport demand management (TDM) (e.g., Marsden, 2006; Barter, 2012). In Japan, much of the city parking both for commercial and for residential use is market-priced (Axhausen et al., 2015),[1,2] and one of the important factors is the "Act on Assurance of Car Parking Spaces and Other Matters," which mandates that all car owners must secure a parking space for their vehicles (Matsumoto, 2009; Morikawa et al., 2010; Barter, 2011). Hence, price management may be effective in measuring reductions in not only car usage—including that used in commuting and/or shopping trips—but also car ownership itself (e.g., Guo, 2013a; Litman, 2013). Currently, there is no suggestion that parking is being used as a TDM tool in Japan (Matsumoto, 2009; Barter, 2015). For this reason, there is a need to gather empirical evidence and verify its effectiveness.

In this regard, this study evaluates the residential parking rent price elasticity of car ownership. We use household-level micro data captured through Japan's National Survey of Family Income and Expenditure for 2004. These data allow us to

* Corresponding author.
E-mail addresses: hseya@hiroshima-u.ac.jp (H. Seya), nakamichi@ide.titech.ac.jp (K. Nakamichi), yamagata@nies.go.jp (Y. Yamagata).

[1] The land in central business district areas in Japan is occupied by many small, unmanned parking lots, with prices differentiated based on time and space. Typically, parking lots for commercial use are rented on an hourly basis for visitors, while lots for residential use are rented on a monthly basis for residents.

[2] Axhausen et al. (2015) argued that Japanese cities are a good approximation of the Shoup (2005) approach, because the majority of city parking lots are market-priced. Spatial price competition among parking lots was analyzed by Seya et al. (in press, 2015).

http://dx.doi.org/10.1016/j.tra.2016.01.005
0965-8564/

explain the number of cars owned by a household bearing various attributes, including the expenditure for a parking lot rented on a monthly basis. Typically, the expenditure for renting a parking space is observed only when a household owns one or more cars; hence, it is important to estimate the parking rent price when a household has no car. Additionally, the parking rent price is not observed for housing yard/on-site garage owners who can park their cars there, free of charge.

To impute such variables whose values are missing not at random (MNAR), in the sense of Rubin (1976), we employ the propensity score matching method (e.g., Peikes et al., 2008), in which sample records with no expenditure for renting a parking space are matched to sample records with an expenditure and similar conditions in terms of land use, household attributes, and housing attributes. We then apply the ordered probit model while considering the endogeneity of the parking rent price, which is caused by a measurement error in the generated (imputed) regressor. This study also compares differences in elasticity by city size. This is because in rural areas, where public transportation services are poor, it may be unrealistic to implement PPM, as such policies may dramatically reduce residents' quality of life. However, in the case of city centers, where an alternative transportation mode is fairly convenient to use, such policies may be plausible.

Our results show that the effects of parking prices on car ownership are negative and statistically significant, at least at the 10% level. However, its elasticity is, at most, 0.48 in absolute terms, which is fairly inelastic. The elasticity value varies depending on city size; for megacities, elasticity is always negative for car ownership, whereas for middle-sized or small cities, towns, and villages, elasticity is positive for one-car ownership and negative for the ownership of more than one car. Hence, when the price of parking increases, some people may switch from more than one car to one car and some people in megacities may switch from one to zero cars. Indeed, the net effect of a price increase may be that non-car ownership increases in megacities and one-car ownership increases in other cities.

The remainder of this paper consists of four sections. Section 2 reviews previous studies of PPM to analyze residential use and car ownership. Section 3 describes the models we use in our empirical analyses. Section 4 introduces the household-level micro data captured by the National Survey of Family Income and Expenditure, followed by an empirical investigation that examines residential parking rent price elasticity. Section 5 concludes this paper.

2. Literature review

Here, let us first review previous studies of PPM for residential use. Retzko (1994) highlighted the concept of an area-wide parking management scheme, including park-and-ride, in Germany, where the charge would vary depending on the type of district (i.e., urban area, suburban area, city center, etc.). Although this concept seems comprehensive, that study focused on destination (e.g., workplace)-based PPM rather than origin (e.g., home/residential)-based PPM, and therefore, residential parking was not discussed intensively. Borgers et al. (2008) assessed the effects of restrained car access on preferences for new residential areas. One of their findings was that although most people prefer to live in non-car-restrained residential areas, the negative effects of concentrated parking facilities can be compensated for by access to public transport at a short distance from homes. Woldeamanuel et al. (2009) and Guo (2013a) investigated the effects of parking usability on car ownership; however, those studies considered the usability of residential parking by using a dummy variable, and neither used parking price information.

Guo (2013a,b) showed that off-street parking supply may be positively associated with car ownership, whereas on-street crowding level may be negatively associated with car ownership in New York. Marsden (2006) noted the problem of residential parking supply restrictions, which can generate substantial overspill onto on-street parking problems that detract from the quality of the local street environment. In fact, the majority of parking lots are off-street in Japan (Axhausen et al., 2015; Seya et al., in press, 2015) and therefore such an externality may be weaker compared with Europe and the United States. Further, scholars in the Netherlands have analyzed the impacts of parking permits on car ownership. De Groote et al. (2015) indicated that an additional year of waiting for a parking permit reduces car ownership by 2 percentage points corresponding to a price elasticity of car demand of −0.8. Van Ommeren et al. (2014) suggested that the provision of residential parking permits in downtown shopping districts induces a yearly welfare loss of about 275 euros per permit.

Because we are constructing a model of car ownership, we also need to review the literature related to car ownership modeling. Thus far, numerous empirical investigations have examined the effects of household characteristics and/or neighborhood attributes on car ownership and/or car usage (Anowar et al., 2014; Chingcuanco and Miller, 2014). Anowar et al. (2014) reviewed the related literature while focusing on modeling aspects. The reviewed methodologies included standard static discrete choice models, count models, discrete continuous models, structural equation models, and duration models. They provided a decision matrix to help researchers and practitioners determine appropriate model frameworks for conducting car ownership analyses. Matas et al. (2009) assessed the effects of the urban structure on household car ownership in Barcelona and Madrid, using an ordered probit model; their results showed that the time cost to access jobs by public transport is a determinant of car ownership. They also found that the elasticity values for average car ownership are −0.25 for Barcelona and −0.19 for Madrid. Delbosc (2013) examined the influences of household size and composition on travel behavior in Melbourne; she found that the largest influence on car saturation was the number of adults in the household: households with three adults were 45% less likely to be car-saturated than one-adult households. Caulfield (2012) examined the characteristics of households with multiple-car ownership in Dublin, using a multinomial logit model with finely categorized bus stop density and residential density data as explanatory variables. The results showed that both bus stop density