A study on the solution of illegal parking for bicycles

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Abstract

This paper aims to analyze the solution of illegal parking for bicycles. We can see quite a few illegal parking bicycles in sidewalks near stations and shopping malls although there are several parking lots. In this paper, classifying parking demand into short time and long time parking demand, I estimate the characteristics of short time parking demand using empirical analysis.

In conclusion, city authorities should construct parking lots near the destination in order to provide high quality parking lots. And even if city authorities construct free parking lots in the sidewalks, people doing illegal parking do not tend to park their bicycles at the parking lots.

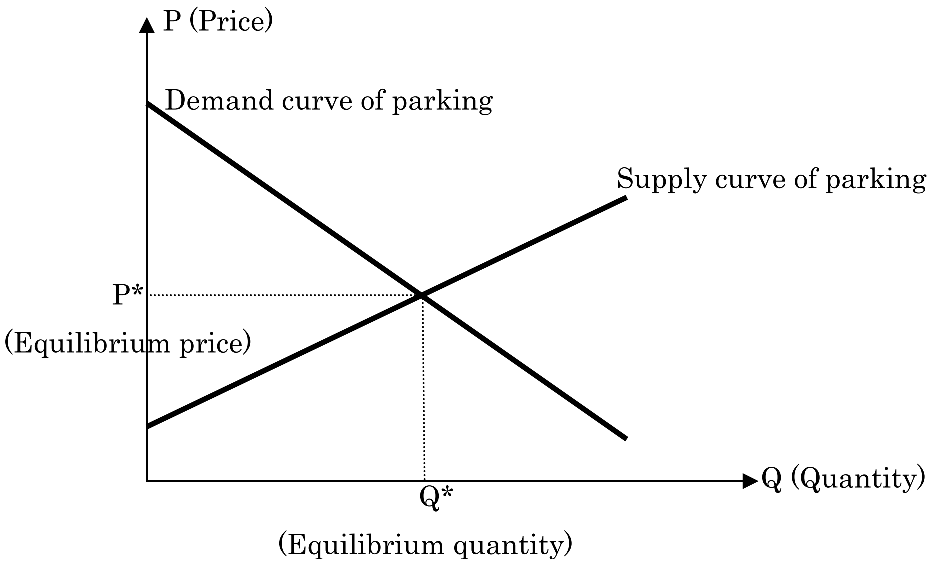
1. Introduction

The purpose of this paper is to considermunicipal policies of small free parking spaces on sidewalks focusing on illegal bicycle parking problems. In Japan, due to the importance of environmental preservation, bicycles are utilized when going shopping and going to stations in the vicinity. Although city authorities and shopping mall owners basically provide bicycle parking lotsfor customers and passengers, some of themtend to park their bicycles on the sidewalks or around the stations and shopping mallsdespite ofno parking zone.

This study divides bicycle parkingdemand intolong time parking demand and short time parking demand. In Japan, due to the rise of global warming issues, bicycles are used by a lot of people when they go to stationsto commute to their office or when they go shopping around the stations. In the case of people commuting to their offices, bicycles tend to be parked for a long time, often from morning until evening.On the other hand, whengoing shopping, bicycles tend to be parked fora short time compared to the previous case. Although city authoritiesbasically provide several pay parking lots around stations and shopping malls, several customers of short time parking demandmight notutilize the pay parking lots.

Hossain et al(2003)indicates that, from the survey data and questionnaire at Saga station in Japan, the use rate of parking lots gradually declines when the distance between destinations and parking lots is longer. Therefore, the consideration of short time parking problem is quite significant for the solution of illegal parking problems. Krizec(2007) indicates that bicycles have the characteristics of public goods, at least quasi public goods, because the market mechanism which generalizes relationship between price and quantity does not sufficiently work in the bicycle market, and it is not feasible to draw out economical value. Parking lots on the sidewalk would also have the characteristics of public goods or quasi-public goods becausebicycle space per one unit is slightif and only if congestiondoes not occur.

Quasi-public goods, as it were, have the characteristics of non excludable goods which are not governed price mechanisms, even if city authorities placeparking spaces on the sidewalks, the amount of illegal parking will not decrease. Hence, the government and city authoritiesneed to guide illegal parkingcustomers and passengers into pay parking lots by means of comprehensive policies. As a result, by equalizing the illegal parking costs to the market price(p*; Figure 1), which is basically equal to the pay parking lot price(p*), we can eliminate illegal parkedbicycles from the sidewalks, and then the price mechanism will work smoothly in the market(Figure 1). Ultimately, the way to solve the illegal parking problem by means of economic methodologies is that the costs of illegal parking[1] should be set the equal to the pay parking lot price. Then, we have to consider the illegal parking problem and the placement of parking spaces on the sidewalks by focusing on the road allocation.



[1]For instance, the costs include the probability of theft and the risk that city authorities remove illegally parked bicycles from the sidewalks.

Figure 1 Equilibrium of parking market

The construction of parking spaces on the sidewalks might lead to the problem of road resource allocation. In Japan, bicycles are defined as one of the vehicles on equal terms with automobiles in the policies after World War 2, and both of them, in principle,used an identical roadway. However, since 1965, due to the rise oftraffic accidents between automobiles and bicycles, the government has enacted several laws in which cyclists are designed special bicycle paths in order to separate bicyclesfrom automobiles and in order to ensure the safety of cyclists. Thelaws mandate that the government constructspecial paths that both cyclists and pedestrians canuse if and only ifspace allows. In other words, the governmentpermits that cyclists and pedestrianscan utilize the same pathsin wide sidewalks in order to isolate bicycles from automobiles. Therefore, on considering the problem of road resource allocation, the construction of small parking spaces onthe wide sidewalksmust be one of the extremely important policies.

Based on the questionnaire, this paper estimatesrandom utility function of parking by Probit model (bilateral choice model) in order to examine whether or not the customers of short time parking demand are able to park their bicycles on the small free parking spaces.

2. Methodology(Utility function approach)

Based on the resultsof the questionnaire[2], this paperwill estimate the random utility function using a discrete choice modelin order to consider the desirable parking spaces.

Suppose that y_1 and y_2 represent the individual utility of the two choices that I denote as U_1 and U_2. The observed indicator equals 1 if $U_1 > U_2$ and 0 if $U_1 < U_2$.

Random utilities when using parking lots or not are as follows:

The random utility of the choice of pay parking lots: U_1

The random utility of the choice of illegal parking: U_2.

Then, if I denote by y=1 the consumer's choice of alternative 1, we have

$$P_1 = \Pr(U_1 > U_2)$$

Pr(*) : The probability of *.

A common formulation is the linear random utility modelof $U_m (m = 1, 2)$, whichconsists of observable variable V_i and unobservable variable ε_i. Also ε_i is assumed a standard normal distribution:

$$U_i = V_i + \varepsilon_i$$

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[2]This questionnaire was surveyed in Kunitachi city (Residential location in Tokyo) in October 2010.

$V_i = \alpha + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \cdots \beta_n X_n$

X: Parameters, *n*: Number of observable variables, *α*: Constant.

Then, if I denote y=1, the consumer's choice of alternative 1, I have

$P_1 = \Pr(U_1 > U_2)$

$P_1 = \Pr(V_1 + \varepsilon_1 > V_2 + \varepsilon_2)$

$P_1 = \Pr(V_1 - V_2 > \varepsilon)\ (\varepsilon = \varepsilon_2 - \varepsilon_1)$.

Next, Table1 and Table2 show respectivelydefinition of variables and descriptive statistics. The software I used in this estimation is TSP 5.0, and the model function is expressed as follows:

$$V_1 - V_2 = cons. + \sum_{i=1}^{n} \beta_i X_i + \mu \quad (i = 1 \cdots n)$$

$$V_1 - V_2 = cons. + \beta_1 \cdot number + \beta_2 \cdot inconvenient + \beta_3 \cdot knowledge + \beta_4 \cdot purpose + \beta_5 \cdot time + \beta_6 \cdot illegal + \beta_7 \cdot distance + \mu .$$

Table 1 Definition of variables

Variable	*Definition*
Park *(Dependent Variable)*	Would you use the free bicycle parking spaces if they are set up along the sidewalk? Yes(1), No(0)
Number	The frequency of the station or mall utilization {three or more per week(3), one or two per week(2), once per monthor less (1)}
Time	Average utilization time 30minutes or less(1), 31~60 minutes(2), 61~90 minutes(3), 91~120 minutes(4), 121 minutes or more(5)
Inconvenient	Have you ever felt inconvenient in lack of parking lots? {always (2), sometimes(1) No(0)}
Knowledge	Do you know some pay parking lots around the station. Yes(1), No(0)
Purpose	Your utilization purpose {Train or bus use(1), Others(0)}
Illegal	Wheredo you usually park your bicycles? {On the road or sidewalk(1), Pay parking lots or free parking lots in shops(0)}
Distance	Desirable distance between your destination and a parking space{50m or less(1), 51m~100m(2), 101m~200m(3), 201m~300m(4)}
Sex	Male (1),Female(0)
Age	10~19years old(1), 20~29(2), 30~39(3), 40~49(4), 50~59(5), 60~69 or more(6)
Residence	Your residence {Within 2 km (1), more than 2 km (0)}

Table 2 Descriptive Statistics

Variable	*(Mean)*	*S.D.*	*(Max)*	*(Min)*	*Variable*	*(Mean)*	*S.D.*	*(Max)*	*(Min)*
Park	0.470	0.500	1	0	*Illegal*	0.644	0.480	1	0
Number	2.376	0.720	3	1	*Distance*	2.552	1.108	4	1
Inconvenient	1.655	0.613	2	0	*Sex*	0.448	0.498	1	0
Knowledge	0.577	0.495	1	0	*Age*	4.163	1.458	6	1
Purpose	0.326	0.469	1	0	*Residence*	0.646	0.479	1	0
Time	3.390	1.518	5	1					

Note: S.D: Standard Deviation

3. Results

Table 3 shows the estimation results. Equation 2 was excluded the parameter of Purpose, and equation 3 was excluded that of individual characteristics. All models are robust.

Table 3 Results

Variable	*Equation1*	*Equation2*	*Equation3*
Constant	1.82(3.84***)	1.83(3.87***)	1.38(3.32***)
Number	-0.51(-4.23***)	-0.51(-4.23***)	-0.52(-4.33***)
Inconvenient	0.50(3.81***)	0.50(3.83***)	0.46(3.56***)
Knowledge	0.89(4.69***)	0.89(4.69***)	0.85(4.65***)
Purpose	0.04(0.25)		0.11(0.70)
Time	-0.27(-4.60***)	-0.27(-4.61***)	-0.27(-4.65***)
Illegal	-0.40(-2.16**)	-0.40(-2.19**)	-0.42(-2.32**)
Distance	-0.15(-1.89*)	-0.15(-1.89*)	-0.16(-2.00**)
Sex	0.19(1.20)	0.19(1.21)	
Age	-0.13(-2.37**)	-0.13(-2.47**)	
Residence	-0.18(-1.03)	-0.17(-1.02)	
(Observations)	362	362	362
(R-squared)	0.41	0.41	0.38
(Log likelihood)	-166.37	-166.40	-170.17

Note: t-statistic in parentheses, t-test***significant at 1%, **5%, *10%

First, according to the coefficient of Number is negative andsignificant at 1% level, the persons using the station and mall frequently might not utilize the parking space on the sidewalks. Second, becausethe coefficient of Inconvenient is positive and significant at

1% level, the persons who feel inconvenient might use the parking space on the sidewalk. Third, becausethe coefficient of Illegal is negative and significant at 5% level, the persons who always park bicycles in illegally areas, even if a parking space on the sidewalk is set up, those persons might not utilize the parking space. This means they might illegally continue to park their bicycles on the sidewalks. Fourth, because the coefficient of Knowledge is positive and significant at 1% level,the persons who know pay parking lots might utilize the parking space on the sidewalks if thisparking space would be placed. And moreover, the value of coefficient is so large that a lot of persons might change from pay parking lots into the free parking space on the sidewalk. Finally, as the coefficient of Distance is negative and significant at 5% or 10% level, when the distance between two is longer, the persons tend not to utilize the parking space on the sidewalk.

4.Conclusions

Here, from the estimation result, let mediscusscrucial points.

People usually parking their bicycle in no parking area might not park it on the free parking spaces even if several parking lots are set up on the sidewalks.Therefore, city authorities shouldremove illegal parking bicycles from sidewalks and need to be monitoring illegal parking bicycles.

Next, passengers and customers hope that parking space is near their destination. Therefore, in order to provide high quality bicycle parking spaces, city authorities should set up several small parking spaces on the sidewalks. In other words,several small parking lots are superior to a large parking lot.

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