Charging for Parking at Government Offices to Reduce Passenger Car Trips: a Case Study of Seoul Metropolitan Area

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Abstract

This study aims to introduce "stick and carrot" concept in implementing parking policy at the government offices, i.e., parking charge for passenger car users as stick and a subsidy for mass transit users as carrot.

Parking price for government employee has been determined to be at the point when the demand of parking meets the capacity of parking space. A logit function formed by travel cost and travel time parameters is utilized to determine the demand of parking. The proper parking charges are estimated to be 60,000 won/month for CBD area and 40,000 won/month for suburban area. The amount of subsidy for mass transit users was suggested to be 30,000 won/month as an incentive for giving up passenger car.

1. Introduction

Economic growth in the 1980s has been bringing about a rapid increase in the number of passenger car ownership. However, the length of road has nearly increased. This situation has resulted in traffic congestion and the preference for passenger car to mass transit, deteriorating the level of mass transit service relatively. Above all, 85 percent of total vehicles on roads during peak hours are drive-alone passenger cars, while only 14 percent of passengers are transported by passenger car. This vicious cycle caused a various of traffic problems including parking problems and traffic congestions.

To cope with these problems, Korean government has set up a policy direction to charge for parking at both on and off streets. As a part of this policy, government offices where parking is deemed to be free are also under consideration to adopt a toll parking lot system.

This study aims to introduce "stick and carrot" concept in implementing parking policy at the government offices, i.e., parking charge for passenger car users as stick and a subsidy for mass transit users as carrot in order to reduce passenger car trips as well as to increase mass transit trips. It estimates, for government employee, the reasonable parking price and the moderate amount of subsidy for mass transit use. Then, it also suggests the parking price for visitors.

2. Current Transport Status at Government Offices

2.1 Study Area

Three government offices are chosen as study area, which of all are located at Seoul Metropolitan Area(SMA) where twenty-one government offices are. Two of them are placed at CBD: the Office of Supply and the Korea Maritime and Port Administration(KMPA). The other one is sited at suburban area: the Second government Complex at Gwachon.

2.2 Parking Space and Transport Facility for the Study Area

2.2.1 Parking Space and the Pattern of its Use

Demand for parking is found to far exceed the capacity of parking space for all the three government offices. The exceeded parking demand is discovered to park at the outside of parking line at parking lot or another parking facility outside government offices.

Table 1. Parking Space and the pattern of its use

Unit: # of parking space, # of passenger cars

		The Office of Supply	KMPA	The 2nd Gov't Complex
Supply (A)	. Employee	142	90	2,476
	. Visitors	136	14	293
Demand (B)	. Employee	188	119	2,772
	. Visitors	175	31	1,176
B/A	. Employee	1.33	1.32	1.12

2.2.2 Transport Facility around Study Area

Public transport facility such as subway and public bus system is well developed around government offices in the study area. Especially, commuter bus system is well being operated for going to work and for going home.

Table 2. Transport facility around government offices in the study area

	The Office of Supply	KMPA	The 2nd Gov't Complex
Subway	Seocho St. (Line 2)	Jongro 5 St. (Line 1)	Gov't Complex St. (Line 4)
Public bus	Good	Excellent	Good
Commuter bus	Good	Good	Excellent
Traffic congestion around office	Moderate	Severe	More or less severe
Public parking lot outside office	Not available	A few of toll parking lots	A lot of free parking lots

2.3. Traffic Patterns of Government Employee

2.3.1 Passenger car Ownerships

Approximately 55 percent of total government employee have their own passenger cars in the study area. 58.8 percent of employee at the Office of Supply, 49.4 percent of employee at KMPA, and 58.9 percent of employee at the Gwachon 2nd Government Complex.

Table 3. Passenger Car Ownerships of Government Employee

Unit: # of people, %

	The Office of Supply		KMPA		The 2nd Gov't Complex	
	Responders	Percent	Responders	Percent	Responders	Percent
Person owned Car	242	58.8	135	49.4	433	58.9
Person not owned Car	170	41.2	138	50.6	302	41.1
Total	412	100.0	273	100.0	735	100.0

2.3.2 Mode Shares for Commuting

Most of government employee use public transit for commuting. 60%~80% portion of commuting are made by subway, public buses, or commuter buses. Trips by passenger cars are 33 percent at the Office of Supply, 20.5 percent at KMPA, and 38.7 percent at the Gwachon 2nd government Complex. The discrepancy of passenger car trip portion are due to variables such as the number of parking space, accessability of public transit, and traffic congestion around government offices. In case of commuter buses, the employee at the Gwachon 2nd government complex seem to prefer to use them than the other offices, since commuter bus lines connecting the Gwachon 2nd government office are well organized compared to the others.

Table 4. Mode Shares for Government Employee's Commuting

Unit: # of people, %

Mode	The Office of Supply		KMPA		The 2nd Gov't Complex	
	Responders	Percent	Responders	Percent	Responders	Percent
Passenger cars	136	33.0	56	20.5	285	38.7
Public transit	257	62.4	215	78.6	297	40.4
Commuter bus	19	4.6	2	9.7	153	20.8
Total	412	100.0	273	100.0	735	100.0

2.3.3 Reasons of Preference for a Passenger Car

Employee who use their own cars for commuting said they prefer to take passenger cars as following major reasons:

- Lower transit services (53.0%)
- To make commuting time shorter by passenger cars (20.8%)
- To use their passenger car before, during, or after working hour (19.7%).

2.4. Traffic Patterns of Visitors to Government Offices

2.4.1 Mode Shares

About 55% of visitors to government offices are found to bring their own passenger cars. In the case of the Office of Supply, the 70% portion of visitors prefer to use a passenger car, while those of the other two offices are near 50%. The reason why the portion of taking passenger car at the Office of Supply is higher than the others is deemed to be that the availability of parking space is higher and traffic congestion around office is relatively better.

Table 5. Mode Shares for Visitors to Government Offices

Mode	The Office of Supply		KMPA		The 2nd Gov't Complex	
	Responders	Percent	Responders	Percent	Responders	Percent
Passenger car	70	70.0	20	51.2	180	51.7
Public transit	30	30.0	19	48.7	168	48.2
Total	100	100.0	39	100.0	348	100.0

2.4.2 Distribution of Parking Duration

Parking duration of visitors who park at offices mainly falls into the range between 1 hour and 1.5 hours (25.9%), the range between 0.5 hours to 1 hour (23.3%), and less than 0.5 hours (12.2%).

2.4.3 Reasons of Preference for a Passenger Car

Visitors who use their own cars said they prefer to take passenger cars as following major reasons:

- To make travel time shorter by private cars (40.0%)
- Lower transit services (28.1%)
- To use their passenger car before, during, or after working hour (21.4%).

3. The Optimal Parking Charge for Government Employee

3.1 Approaches

Two different methods are performed to determine the optimal parking charge for government employee. First of all, Utility function formed by travel costs and travel time, which is used to explain the behavior of choosing transport mode, is utilized to analyze the parking demand in response of parking charge's magnitude. Secondly, the private car users are surveyed to find out the maximum parking charge up to which they are willing to bring their own cars out.

Based on these two approaches, parking price for government employee has been determined to be at the point when the demand of parking meets the capacity of parking space.

3.2 Determination of the optimal parking charge by utility function

Logit model, commonly used in Modal Split in Urban Transportation Planning Process (UTPP), can be applied in order to identify the choice of private car or public transit. In this study, modal split has been performed by binary logit model which considers only two different modes, private car and public transit.

The probability of choosing each mode is, then, represented as followings:

$$P_a = \frac{e^{u_a}}{e^{u_a} + e^{u_b}} \quad \cdots\cdots (1)$$

Where, P_a = Probability of selecting private car
$1\text{-}P_a$ (= P_b)=Probability of selecting public transit
U_a = Utility function of private car
U_b = Utility function of public transit

Travel time, comfort, convenience, travel cost, etc., should be considered in obtaining a utility function. In this study, travel time and costs are considered as significant factors that affect the choice of travel mode. Comfort and convenience effects are considered by means of dummy variable. Finally, they are represented as followings:

$$U_i = \alpha T_i - \beta C_i - \text{Dummy} \quad \cdots\cdots (2)$$

Where, U_i = Utility function of mode i
α, β = Parameters for time and cost
T_i = Travel time for mode i (Unit : minute)
C_i = Travel cost for mode i (Unit : 1,000 won)
Dummy = Dummy variable

The coefficient of travel time and travel cost in utility function is calibrated based on surveyed data and are found to be as follows:

For suburban area,

$$U_i = -0.02164 * T_i - 0.139086 * C_i - 0.755354 * \text{DUMMY} \cdots\cdots (3)$$

Where, Dummy value are to be 0 for private car, 1 for public transit.

For CBD area,

$$U_i = -0.023541 * T_i - 0.089351 * C_i - 0.438759 * \text{DUMMY} \cdots\cdots (4)$$

Where, Dummy value are to be 1 for private car, 0 for public transit.

Based on these utility function, probability of selecting private car against $\triangle U$ (U_A-U_B) are plotted.

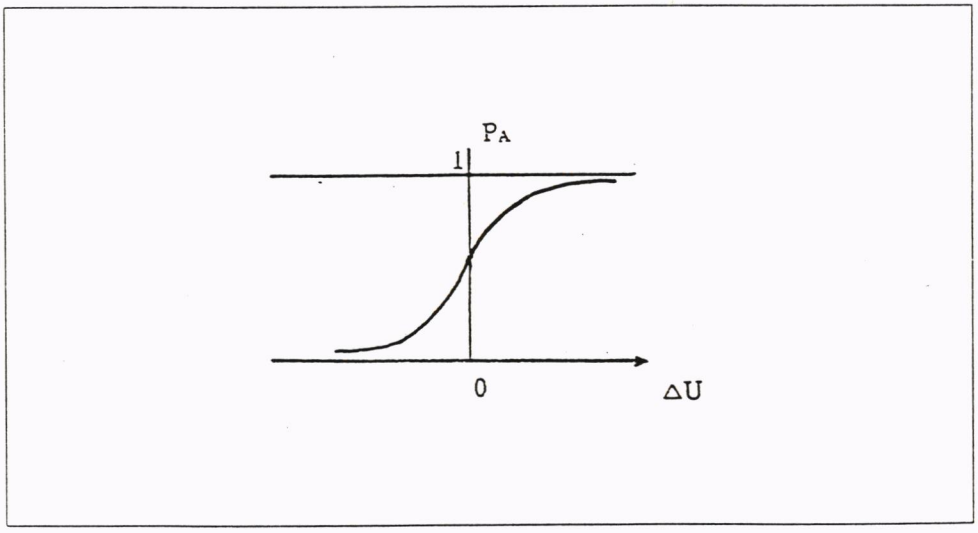

Figure 1. Relationship between P_a and $\triangle U$ (U_A-U_B)

The number of private cars owners who are willing to pay is estimated at the variation of parking charges according to the utility function. Then, the optimal parking charge is determined to be at the point when the demand of parking exactly meets the capacity of parking space. The proper parking charges by this method are estimated to be 60,000 won/month for CBD area and 40,000 won/month for suburban area.

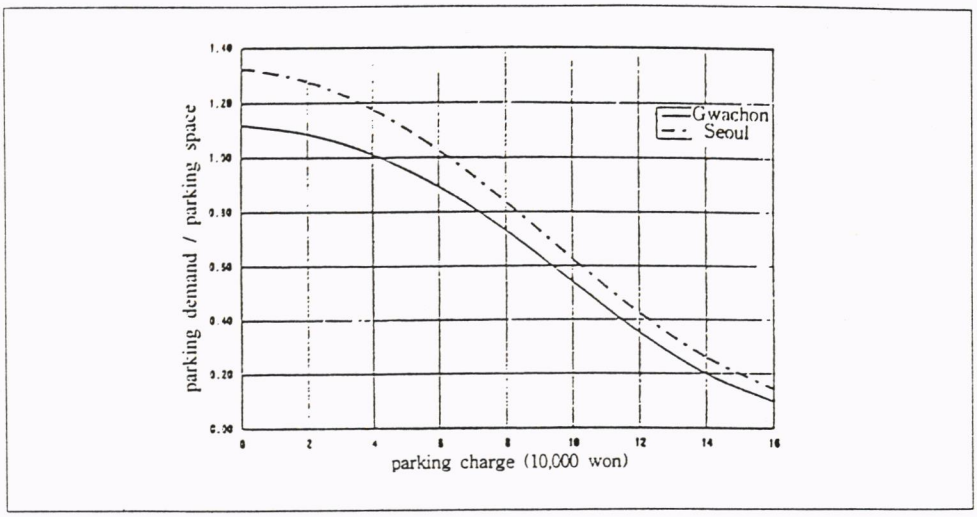

Figure 2. The ratio of parking demand / parking space at the variation of parking charges

3.3 Determination of the optimal parking charge by survey data

The critical parking charge at which point private car owners are reluctant to bring their cars was asked through questionnaire. Based on this survey data, the ratio of parking demand over parking space is calculated at the variation of parking charges.

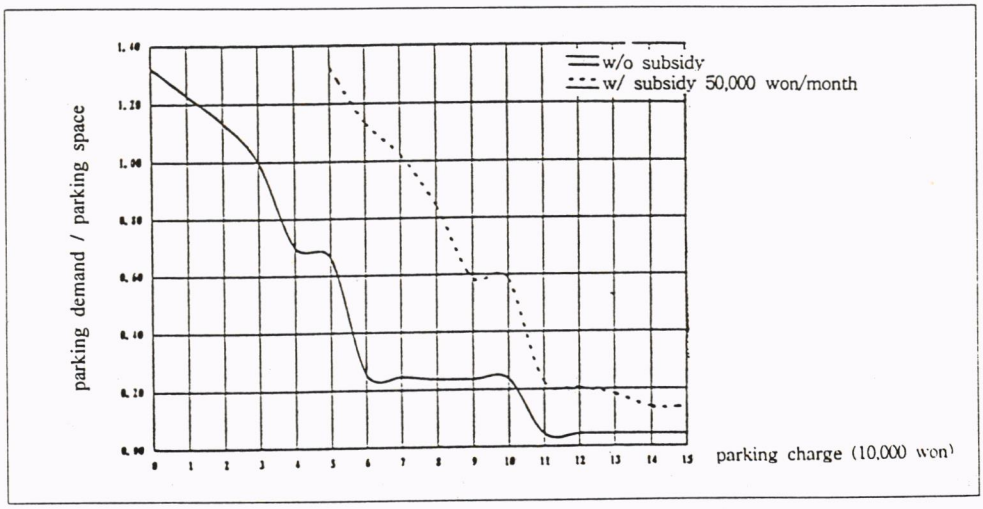

Figure 3. Parking demand by parking charges (CBD area)

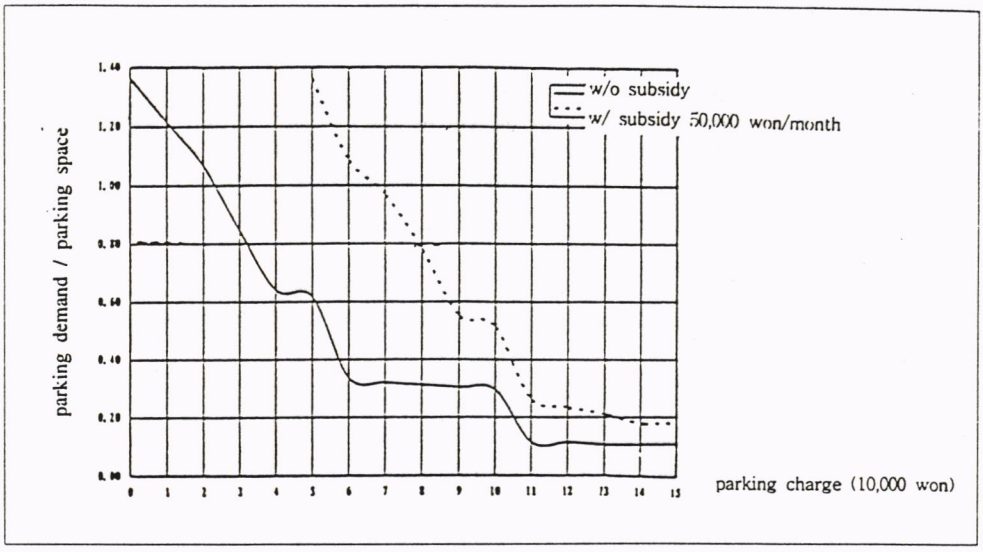

Figure 4. Parking demand by parking charges (Suburban area)

The optimal parking charge is deemed to be at the point when the demand of parking exactly meets parking capacity at the area concerned. The proper parking charges by this method are estimated to be 30,000 won/month for CBD area and 25,000 won/month for suburban area.

3.4. The Optimal Parking Charge for Government Employee

Two different optimal parking charge is estimated by using utility function and by survey data. The optimal parking charge is recommenced to be values suggested through utility function method. This is because the elasticity of parking demand is deemed to be exaggerated by survey method.

Finally, the optimal parking charges is estimated to be 60,000 won/month for CBD area and 40,000 won/month for suburban area.

4. The optimal parking charge for visitors

4.1 Approaches

The optimal parking charge for visitors is, also, estimated by two different methods. One is done through questionnaire. The other is rooted at the on-going trend of parking charges.

4.2. The optimal visitor's parking charge by survey data

The maximum parking charge which visitors are willing to pay is asked. Then, the accumulated maximum parking charge versus the demand of visitor's parking is plotted. Parking charges ranged from 500 won/hour to 1,500 won/hour are found to have higher elasticity of parking demand against parking charges.

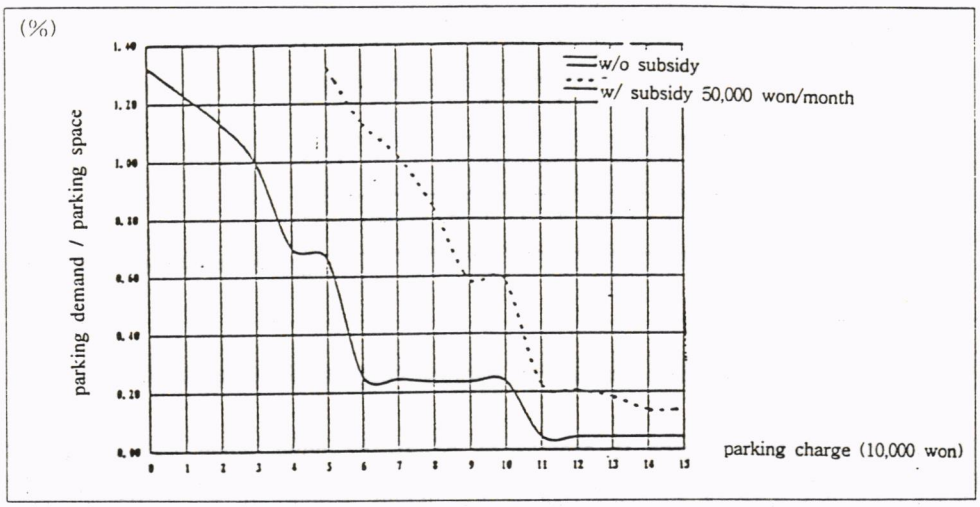

Figure 5. The accumulated parking charge vs. visitor's parking demand (CBD area)

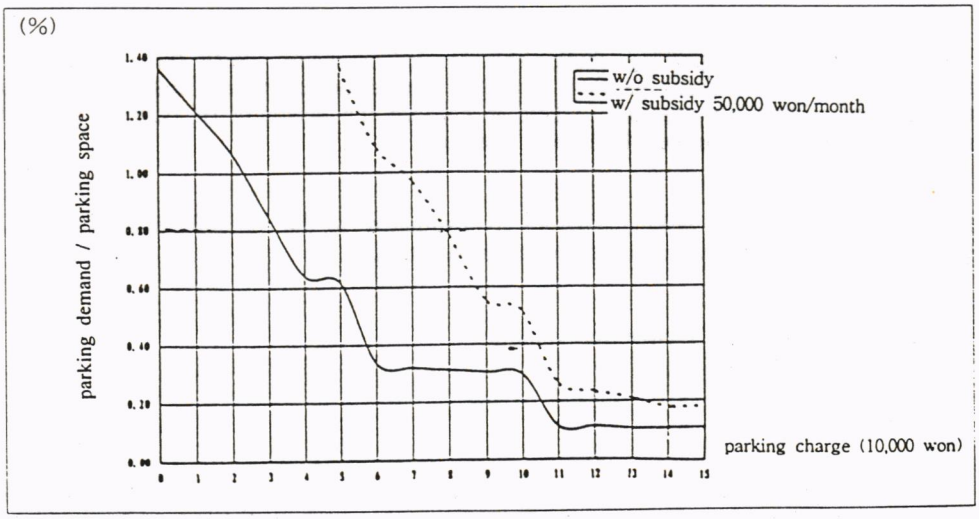

Figure 6. The accumulated parking charge vs. visitor's parking demand (Suburban area)

4.3. The optimal visitor's parking charge by on-going parking charge trend

On/off street parking charges at Seoul Metropolitan Area(SMA) range from 1,000 won to 2,000 won for 30 minutes by land use types. For the CBD area, parking charges are 2,000 won/30 minutes and 1,000 won/ 30 minutes for the other areas.

Table 3. On-going on/off street charges at Seoul Metropolitan Area(SMA)

Unit: 30 Minutes

	On street	Off street
CBD area	2,000 won	1,600 won
The other area	1,000 won	1,000 won
Park & ride parking lot	200 won	200 won

4.4. Determination of parking charges for visitors

The optimal parking charge for visitors is suggested to be 1,000 won per 30 minutes. The magnitude of parking charge can, however, be adjusted according to the level of on/off street parking charges in the neighborhood of government offices concerned.

5. Determination of Mass Transit Subsidy for Government Employee

Subsidy for mass transit use is suggested as an incentive for giving up passenger car in case of government employee. The amount of subsidy is estimated 1,200 won/working day, which amounts to a round trip by subway and shuttle bus. Therefore, 30,000 won/month is determined as subsidy for mass transit since the number of working days in a month are 25 days or so.

References

1. Kim, S. (1995) A Simulation Model for High Occupancy Vehicle (HOV) Lane Operation on Express Highways in Korea, 1st EASTS, Manila, Philippine, September, 1995.