Modeling the Response to Parking Policy

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ABSTRACT

Parking policy is one of the most powerful means urban planners and policy makers can use to manage travel demand and traffic in city centers. Since urban access is considered crucial to the economic success of a downtown area, certain constituencies, such as business and retail, have historically been opposed to any parking restriction policies. In order to address these concerns and create appropriate parking policies, it is important to understand how visitors to the city center are likely to respond to new policies.

This paper presents a model to estimate the likely response to two parking policy alternatives in the Carmel Center area of Haifa, Israel: an increase in parking cost and a decrease in parking availability that will increase the driver search time for parking. The model is based on the responses of center visitors to a stated preference survey. Three different models were estimated: a binary model, a multinomial logit, and a nested model.

The results show that workers are more likely to change their mode of travel or time of day than to change destination or cancel their activity. Non-workers are likely to make all types of changes and for all policies they are more sensitive than workers. These results suggest that parking measures may be effective in reducing congestion in the business district. However, they may also have a negative effect on the vitality of the business district as shoppers and other visitors are likely to go to other places in response to the change.

INTRODUCTION

Parking policy is one of the most powerful means urban planners and policy makers can use to manage travel demand and traffic in city centers. In many countries, governments are increasingly using parking policies as a means of reducing urban road traffic (1,2,3). Many researchers believe that parking measures are effective means of reducing congestion (1,4).

No parking restriction policies have been applied so far in Israel. In fact, Israel is now at a juncture at which it has to determine its parking policy. Parking standards in Israel are currently defined in terms of a minimum requirement for different land uses. There is no distinction in the current standards among city centers and suburban areas.

Given the political fragility of parking policies and the lack of evidence of the effects of actual changes to parking policies in Israel, there is need for research into the potential effects of such policies. The purpose of this paper is to study the potential response of city center bound travelers to parking restriction policies through a response model based on stated preference data. This research will help understand the role of parking policy in developing sustainable transportation programs.

BACKGROUND

Parking Policy as a Travel Demand Management Strategy

Parking can be effectively managed through several types of policy interventions. These include controls on the number of parking spaces, their spatial distribution, parking costs, parking time limits, residential parking permits, taxes, provision of employee parking, and levels of policy enforcement. The total amount of parking available in the city center can affect the amount of traffic entering the area, and the location and layout of these spaces can affect the movement of traffic within the center. On-street parking reduces the traffic capacity of roads in and approaching the center. Parking programs, however, do not typically affect through-traffic. Such programs may even increase both through-traffic and the number of chauffeur-driven cars.

Parking management can be used to encourage people to shift from private cars to public transportation. Parking policy, however, can have other effects on travel patterns. It may encourage people to travel to other destinations, change the time of day of the trip, and change or cancel their activities. In the long run, it may even cause businesses to move outside the existing business district, thereby dispersing activities and increasing dependency on the private vehicle. Such a response to a new parking policy may increase congestion and air pollution in the long term, and thus achieve the reverse effects of those intended in implementing the measure.

The objective of a parking-management program should be to increase the attractiveness of the CBD as much as possible by encouraging people to change their choice of travel mode and travel time without discouraging them from coming to the city center. A good parking policy should restrain commuting by car without hindering shoppers and people doing personal business. Commuters can only shift their travel mode and occasionally the time of day of their trip, but shoppers and other visitors can also shift their destination or even cancel the trip thus affecting the economics of the center.

The benefits and costs of parking management programs should be carefully studied before implementation. Benefits include reduced travel time and costs for some users, improved downtown amenity, and potentially improved economic activity, reduced air pollution, noise pollution and energy consumption, more productive land use, and a reduced need to expand highways. Costs include a potential decline in economic activity, an increase in administration costs, larger transit deficits, higher travel time and operating costs for users who change their travel patterns to avoid the restraint penalty, and potentially increased congestion outside the area where the measure is applied. Finally, revenue from increased parking rates should be considered neither a benefit nor a cost, but rather a transfer of resources.

To evaluate the potential benefits of parking measures and to learn how parking policy functions as a powerful transportation-planning tool, we need an improved understanding of people's responses to them. We need to understand how parking policies affect the demand for and the supply of parking, and how parking demand and supply in turn affect the vitality and value of the CBD.

The need to study the effect of parking policies is magnified given the traditional opposition to parking restrictions from state and local officials, business interests, and the general public (5). For a long time it was an article of faith that when it comes to parking, more is better. This position is especially strong among downtown retailing communities, who view parking restrictions as a threat to their business (6). In a recent survey of CBD retailers in Philadelphia, 36 out of 98 respondents suggested that improving parking would be the most important change that could help their business (3). In a recent survey conducted by the author in Haifa, it was found that parking is the second most important factor in location decision-making for business and second only to rent.

Studying the Effect of Parking Policy

Little data and information, however, are available either on the potential impact of parking measures on people’s travel behavior patterns or on the long-term effects of such measures. The few existing studies are either empirical studies, which look at the before-and-after implementation of a parking policy, or simulation studies, in which travel demand models are used to evaluate the potential effect of a parking policy.

Examples of empirical studies include Thomson (7), U.S. Department of Transportation (6), Mehranian et al. (8), Surber et al. (9), Willson (10), Willson and Shoup (11), and Shoup and Willson (12). The advantage of the empirical studies is that they look at actual changes in travel patterns resulting from the implementation of such parking policies.

There are two main problems with empirical studies: first, it is difficult to isolate the effect of a parking measure from other external effects; second, it is very difficult to identify the trips that are most affected. Identifying the affected trips is very important in gauging the outcome of the policy. As noted earlier, if most of the trips affected are work trips, then the measure is very successful; however, if most are shopping or other visitors trips, then the measure may have a negative effect.

Examples of modeling and simulation modeling studies include Gillen (13), and Gomez-Ibanes and Fauth (14). The main problem of the modeling and simulation studies is their reliability. The ability of the model to correctly predict the response to parking measures is questionable, especially since these models have not usually been calibrated for such purposes, but have been developed mainly for the evaluation of new infrastructure.

METHODOLOGY

Given the problems of the simulation studies, and the lack of the before and after data regarding parking restrictions in Israel, it was decided to estimate a response model based on stated preference data. The problems of stated preference data and models are well recognized (see, for example, Beaton et al. (15); and Bates, (16)). However, given the lack of revealed preference data, the stated preference approach was chosen. The purpose of the model is not to provide accurate estimates of changes in travel behavior as result of specific parking policies, but to get an initial indication of the likely behavioral changes of travelers under such policies and thereby better understand their implications for the development of sustainable transportation. The are two major advantages to the response model:

- It can model different type of responses - not merely mode shifts.

- It can differentiate between workers and non-workers. As explained above, understanding who is affected is very important for the analysis of the cost and benefits of the policy.

A stated preference survey of 240 car drivers arriving at the Carmel Center in Haifa was conducted to study their response to changes in parking policies. The survey was conducted in two phases. Some qualitative results of the first phase appear in Shiftan (17). The second phase enriched the data with sufficient observations to develop a response model. The Carmel Center is one of the few business districts in the city of Haifa. This center is of mixed land use, catering to residential, commercial, services, and leisure activities. As such, the center serves as a regional business district for the local neighborhood as well as constituting one of the major business districts in Haifa. It is a traditional urban central business district composed of small shops, services, offices, and leisure activities and without a major shopping mall. It does have a small shopping mall that is part of an apartment and hotel complex.

The survey focused on automobile drivers, who were asked a series of questions about the trip they had just made including: origin, arrival time, trip purpose, the time needed to find parking and to walk from the parking location to destination, and the type of parking (paid/free and on/off street). The stated preference part of the survey included experiments asking drivers for their potential response to an increase in hourly parking rates from their current rate of 3.70 New Israeli Shekels (NIS) to 5, 7, and 10 NIS and to a reduction in the number of available parking spaces. Four NIS were equal about one U.S. dollar at the time of the survey. The reduction in parking spaces was presented to the respondents in term of an increase in the time needed to find a parking space of 10, 15, or 20 minutes. For each question, respondents were asked to choose one of seven potential responses:

- continue to arrive by car, without a change in their behavior

- shift to public transportation,
- shift to taxi,
- shift to walk,
- cancel the trip,
- change destination, and
- change time of day.

Each of the 240 respondents was asked to respond to six different choice experiments. Their responses provided a database of 1,440 observations for model estimation. Finally the survey contained some demographic and socioeconomic questions regarding age, marital status, household size, children, auto ownership, number of drivers, and income.

The survey data were used to estimate the response model. The model is specified as a multinomial logit (MNL) or nested logit (NL), where the utility of each alternative response is specified as:

$$U_i = V_i + \varepsilon_i$$

Where U_i is the utility of alternative response i for a given traveler; V_i is the systematic component and ε_i is its random component. The systematic component of the utility can be written as:

$$V_i = \beta' X_i$$

Where X_i is a vector of attributes for alternative i, with some of them interacting with traveler characteristics, and β is a vector of coefficients. In the MNL model, ε_i is Gumbel distributed, independently and identically across alternatives, and the probability that alternative i will be chosen is

$$p(i) = \frac{\exp(\mu V_i)}{\sum_{i \in L} \exp(\mu V_i)}$$

where μ is the scale parameter, and L is the set of available alternatives.

THE SAMPLE

The sample was comprised of 26 percent work trips and 74 percent non-work trips. The non-work trips were roughly equally divided into shopping trips, entertainment trips, and errand trips. 64 percent of the drivers drove alone, 25 percent had one passenger in the car, and 11percent had at least two passengers with them. 54 percent of the respondents own one vehicle, 36 percent own two vehicles, 8 percent own three or more vehicles, and 2 percent of the respondents arrived in a vehicle they did not own. 34 percent of the respondents are from households with two people, 42 percent from households of three or four people, and 24 percent are from households with five or more people. The sample was equally divided among people younger than 35 and older than 35.

Slightly over half of the respondents paid for parking and this share is about the same for work trips and for non-work trips. Among those who parked for free, 72 percent parked on the curbside and 28 percent parked in employee parking. Among those who paid for parking, 76 percent parked on the curbside and 24 percent parked in parking lots. About 60 percent of the respondents spend less than five minutes searching for parking. This percentage is 70 percent among those who paid for parking and 50 percent among those who parked for free. This finding suggests it take more time to find a free parking space.

Regarding the expected parking time, 34 percent of the respondents expected to stay in the Carmel Center for less than an hour, 32 percent between an hour and a couple of hours, and 17 percent between two and three hours. The rest of the sample, 17 percent, expected to stay for more than three hours; 78 percent of this last group were people who had come to work.

SOME RESULTS

This section presents some of the survey results that indicate the tendencies of the respondents to change their behavior in response to parking policies. More detailed data based on the first survey were presented in Shiftan (17). The focus of this paper is on the response model that will be described in the next section.

Figure 1 shows the response to a policy that will increase parking search time to 10, 15, and 20 minutes and compares these responses for workers and non-workers. As expected, for work trips there is no change in destination and only a small change in time of day and cancellation of trips. Such cancellation can be a result of avoiding trips during the day, for instance during a lunch break, and shows up as an eliminated trip to work. Mode shift was the dominant type of change in behavior among work trips. For non-work trips, all types of changes occur, the most common being mode shift and destination change, both at about the same rate, followed by trip cancellation and, least likely, a change in the time of day of the trip.

A good parking policy should encourage workers to shift mode and time of day, but not discourage visitors from coming to the center. For purposes of analysis, therefore, all travel-behavior responses were categorized into three groups:

- no change in behavior,
- change in mode or time of day - this is considered a positive change, as it will reduce traffic without reducing the number of visitors to the center,
- change in destination or cancellation of the trip - this is considered a negative change, as it will reduce the number of visitors to the centers and, therefore, may affect the vitality of the center.

Figure 2 shows the response by these groups to a policy resulting in a parking search time of 20 minutes for both work and non-work trips. For the whole sample, there is a difference of five percent between those who state they would change mode or time and among those who state they would change destination or cancel their trip. A look at these results by trip purpose shows that among those on a work trip, 47 percent stated they would change mode or time and only 7 percent would change destination or frequency. This result suggests that the policy can be a good one for work trips. The proportion of non-work travelers who state that they would shift mode or time of day is a little smaller (38 percent) to that of commuters; however, there is an additional 44 percent who stated they would either change their destination or cancel their trip. In other words, non-work travelers are far more likely to respond undesirably to parking restrictions by shifting their activity to other centers, an option that does not exist for commuters, at least in the short run. However, such a travel-behavior response by shoppers and other visitors can have a significant effect on the vitality of the center and eventually may cause businesses to move out of the center, as well. In the long run, commuters to these businesses may also shift destination as a result of the policy.

MODEL ESTIMATION RESULTS

The Binary Model

The binary model estimates the probability that a driver to the Carmel Center will change his travel habits as a response to a parking policy that will either raise the parking cost or will reduce parking availability and increase the parking search time. Table 1 shows the results of the binary model for the whole sample and also for a model segmented by trip purpose: work trips versus non-work trips. The first row in each cell of the table shows the estimate of the coefficient and the second row shows the t-statistic in parentheses. All the variables appear in the utility function of changing travel behavior. The last column of the table shows the t-statistic for a test of the equality of the coefficient of the worker segment and the non-worker segment. The different variables and the results of their coefficients' estimates are discussed below. In this discussion the term *significant* refers to the coefficient being significantly different from zero at a 5% confidence level.

Payforpark is a dummy variable that equals one if the driver actually paid for his parking and equals zero otherwise. This variable has a significant negative value showing that those who are already paying for parking are less likely to change their behavior as a result of a more restrictive parking policy. This result is expected as those who are already paying for parking have a higher willingness to pay and most likely a higher need for parking. Also, because the survey specified the new parking cost in absolute money and not as an increase in what the driver is currently paying, the price increase for those who are already paying is smaller. Looking at the results by trip purpose (work versus other), we see that the difference between the worker variable and the non-worker variable is not significant.

Income has a negative and significant coefficient. This shows that people with higher income are less likely to change their behavior as a result of parking restrictions. This makes sense as higher income people have a higher willingness to pay for parking. While the difference between the work variable and the non-work one is not significant, it is interesting that the effect is stronger for non-work trips than for work trips. The coefficient for work trips is not even significant. This may be explained by non-work trips being luxury trips, and the higher one's income the less likely one is to substitute one's first choice for these trips.

Missing income – This is a dummy variable that equals one if income is missing (usually because the respondent refused to answer this question) and equals zero otherwise. The coefficient has a significant negative value showing that missing income behaves similarly to high income. This result is expected because usually the higher earning people are the ones who refuse to answer the question about income. The results by trip purpose show similar effect to that of income.

Duration – This variable represents the visitor's expected duration in the center. This variable has a significant negative coefficient indicating the longer one's visit to the center, the less likely one is to change his or her travel behavior as a result of restricting parking policies. This result is expected for the parking search time that is defined per trip, in which the longer one's stay, the less the cost of the search time is as a portion of one's total activity in the center. However, parking cost was defined per hour, so a visitor who is coming for a longer duration pays a higher absolute parking cost and therefore it is not expected that he will be less likely to change. To test for differences in the effect of duration on stay by type of measure, another model was run in which this coefficient was split into two coefficients, one for cost measure and one for time search measure. This test showed that the coefficient for time search had a higher absolute value, but the coefficient for the cost measure was also negative and significant and the two coefficients were not significantly different from each other. However, this variable in the all purposes model may serve as a proxy for purpose, as commuters come for longer periods and are less likely to change their behaviors than other visitors as commuters have less flexibility. Indeed when segmenting by trip purpose, the variable lost its significance for work trips, but remains negative and significant for non-work trips. The longer duration for non-work trips may also represent some less flexibly scheduled activities.

Household size. This coefficient is positive and significant showing that larger households are more likely to change their travel behavior. This may be a proxy for income per person or for the competition for the car need. The results by trip purpose showed that this variable is significant only for work trips.

Cost and Search Time are the policy variables in the models, both having highly significant positive coefficients. These variables show, as expected, that increasing parking cost or increasing the time needed to search for parking will cause people to change their travel behavior. Looking at the results by trip purpose, the *search time* is significant for all trip purposes and the coefficient for work trips is not significantly different from the coefficient for non-work trips. The *cost* coefficient, however, is significantly different for workers and non-workers and it is significant only for non-work trips. This may be because some workers are reimbursed for their parking expenses.

For both measures: parking cost and parking search time, the coefficient for non-workers is higher than the coefficient for workers showing that non-workers are more likely to change their behavior in response to these measures than workers. This finding is an important result of the study. It shows that commuters are the least likely to change their travel behavior as a response to parking restriction policies. The next important question is what type of change commuter and other visitors will make in response to restricting parking policies and whether they will continue to come to the center. This will be discussed in the multinomial model.

Board refers to the number of buses needed to be taken for the visitor to arrive at the center by public transportation. This variable has a negative and significant coefficient indicating that the more transfers the person has to make if he comes to the center by public transportation, the less likely he is to change his travel behavior in response to parking restriction policies. This is clear as one of the common responses is shifting mode to public transportation. This coefficient is significantly higher for workers than non-workers showing that workers are much less willing to accept the inconvenience of bus transfer. It is interesting that this was the only level of service variable that was significant. Other level of service variables that were tested include travel time by bus, walking time to bus, waiting time for bus, and travel time by car.

Young is a dummy variable that equals one if the respondent is under the age of 40. The coefficient is positive and significant indicating that younger people are more likely to change their travel behavior in response to parking restriction policies. This may be a proxy for income level, and may also suggest that younger people are more flexible and willing to make changes. This variable was not significantly different among work trips and non-work trips.

Value of time – The value of time derived from the model is calculated as the ratio of the marginal utility of time and the marginal utility of cost. The value of time derived from the common model is 52 NIS/hour. The value of time for work trips is 83 NIS/hour and for non-work trips is 49 NIS/hour. These values are high compare to the average wage rate per hour in Israel, which is about 25 NIS/hour showing that people have high value for their time searching for parking. It is expected that parking search values of time will be higher than in vehicle values of time. Parking search time is viewed by the driver as a complete waste, and because it comprises the last minutes of the total trip, the driver may be pressured to shorten it, to get to his destination on time.

The Multinomial Model

Table 2 presents the results of the multinomial model. This model estimates the probability that the visitor will choose one of six alternatives as a response to one of the parking policies:

1. no change in behavior
2. shift mode to public transportation or walk
3. taxi
4. shift time of day
5. change destination
6. cancel the trip

In this model all the coefficients except the alternative constants were constrained to be equal among alternatives 2,3, and 4 (change time or mode) and among alternatives 5 and 6 (change destination or cancel the activity). While the data were not sufficient to support full model segmentation by trip purposes, partial segmentation was performed for the two policy variables: *cost* and *time*, and for three of the other main variables: *duration*, *income* and *payforpark*. The policy variables were segmented by trip purpose to test the effect of these policies on commuters versus other types of visitors. The *duration* variable was segmented to avoid its serving as a proxy for trip purpose. The table also provides the results of the t-statistic testing for the equality of each pair of coefficients in the multinomial model. The t-statistic tests if the coefficient of a specific variable for the alternatives of changing destination or canceling activities is equal to the coefficient of the same variable for the alternatives of changing mode or time of day. Coefficients of three variables were found to be significantly different at the five-percent level between the alternatives of changing destination or canceling the trip and the alternatives of changing time and mode. The variables demonstrating this difference are *payforpark* for both workers and others, *duration* for both workers and others, and *young*. The following paragraphs provide more detailed explanation for these findings.

Pay for park – Those who are already paying for parking are less likely to change their behavior in response to parking restriction policies. Furthermore, they are less likely to change destination or cancel their trip than to change the trip’s time of day or mode. This result is expected since the people already paying for parking are the travelers who are less flexible and therefore less likely to change destination or cancel activity. This result is similar for both workers and non-workers. Comparing the results of workers and non-workers, we see that workers are much less likely to change destination than other visitors, but they have similar likelihood to change mode or time of day as other visitors.

Duration – The results show that visitors who come for longer periods are less likely to change their behavior in response to parking restrictions. The results of the multinomial model show that these visitors are also less likely to change destination or cancel their activity than to change mode or time of day. In other words, people who are coming for longer period are more committed to their specific activities in the center. This finding holds for both workers and other visitors. Comparing the results for workers and other visitors, we see that workers are less likely than other visitors to change destination or cancel trip, but other visitors are less likely to change mode or time of day.

Young – This variable has a significant positive coefficient for the alternatives of changing mode or time of day, and a non-significant negative coefficient for the alternative of changing destination or canceling the activity. This means that young visitors to the center are more likely to change the mode they use or the time of day of their visit. This finding suggests that parking restricting policies can be more effective on influencing young people to change mode or time of day and not to change destination or cancel trips.

All the variables in which the coefficients were significantly different from each other showed that visitors are more likely to change time of day or mode of travel than to change destination or cancel their trip. This is an encouraging result as changing time or mode is considered positive while changing destination or canceling the trip are considered negative. However, it is also interesting to note that the coefficients of the policy variables, parking cost and parking search time, were not significantly different among the alternatives. In other words, the effect of these variables on encouraging visitors to change mode or time of day is similar to the effect of encouraging them to change destination or cancel the trip and it is impossible to control the type of change through these policy variables.

All policy variables have higher coefficients for non-workers than for workers showing that non-workers are more likely to change their behavior than workers. It is especially worth noting that the coefficient of cost which is specific to a change in destination or a cancellation of trip is not significantly different from zero for workers. This important finding suggests that workers are less likely to change destination or cancel their trip than to change mode or time of day. Other visitors are likely to do all type of changes and are more sensitive to both policies than workers. The policy implications of these results suggest that the parking restricting policies may be efficient in encouraging workers to shift their commuting mode and time of day with minimal effect on their destination and frequency of trips; however, parking policy restrictions will have a more significant effect on other visitors in encouraging all types of travel behavior changes, both negative and positive.

Nested models

Different nested structures that are shown in Figure 3 were tested, but none of them was found to add significant explanatory power to the model. Nested structure I is consistent with the assumption of a hierarchical choice process in which people first consider whether to change time or mode, change destination or cancel the trip, or not to change their behavior. Following this decision the visitor must decide about the specific change within a group of alternatives, i.e. change time or mode within this group, or change destination or cancel the trip within that group. Nested structure II is consistent with a hierarchical choice process in which the person first decides to change his behavior or not. If he decides to change his behavior, then he must select the specific change he will make from a list of alternatives. Finally, nested structure III is consistent with a hierarchical choice process in which the person must first choose whether to change his behavior or not. If he decides to change his behavior, then he has to select a group of change alternatives, and only then can he pick a specific change from the group of alternatives he has selected.

CONCLUSIONS

In this study, a response model was used to estimate the response to different parking policies based on stated preference data. While the use of stated-preference data may include some bias, this approach enabled the modeling of different types of responses, not merely mode shift, and to differentiate between workers and non-workers. These two features of this approach provide a very important advantage in analyzing the implications of such policies to the vitality of city centers.

The results of the model show that workers who drive to the center are more likely to change their mode of travel or time of day than to change destination or cancel their activity. Non-workers are likely to make both types of changes and for both policies they are more sensitive than workers. All visitors who are coming for longer period are more committed to the center and are less likely to change their destination or cancel the trip.

The results suggest that parking measures may be effective in reducing congestion in the business district. However, they may also have a negative effect on the vitality of the business district as shoppers and other visitors are likely to go to other places in response to the change. The effect of parking restriction policies on regional travel patterns and air quality is not yet clear. Further research and more detailed local studies are required before such measures can be implemented.

The implications of the results of this study suggest that parking policies that foster sustainable transportation must be based in part on land use. Parking restrictions can be efficient in employment centers, but can have a negative effect in commercial areas. Furthermore, parking restrictions should be applied only where there is a good supply of public transportation as an alternative mode of travel. People need to be able to shift mode rather than choose one of the negative alternatives of shifting their destination outside the center or canceling their activity altogether. Finally, the targeted manipulation of time limits and parking charges can ensure that commuting by car is discouraged while short-term parking still remains available for other visitors and shoppers.

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LIST OF TABLE AND FIGURE CAPTIONS

TABLE 1 Estimation Results of the Binary Model

Variables	All	Workers	Non workers	T ratio
Constant	-2.954	-6.386	-5.093	-1.206
	(-7.1)	(-6.8)	(-9.7)	
Payforpark	-0.630	-0.7045	-0.540	-0.342
	(-3.9)	(-1.6)	(-2.9)	
Income	-0.239	-0.0307	-0.284	1.093
	(-2.6)	(-0.2)	(-2.5)	
MissIncome	-1.133	-0.944	-1.274	0.446
	(-3.9)	(-1.4)	(-3.7)	
Duration	-0.241	-0.055	-0.211	1.46
	(-6.9)	(-1.0)	(-2.3)	
Hhsize	0.092	0.309	0.057	1.77
	(1.8)	(2.4)	(1.0)	
Cost	0.224	0.1126	0.268	-1.720
	(6.1)	(1.4)	(6.2)	
SearchTime	0.195	0.1554	0.2175	-1.358
	(9.9)	(4.0)	(9.2)	
Board	-0.215	-0.707	-0.1705	3.295
	(-1.8)	(-2.7)	(-1.1)	
Ym	0.382	0.731	0.4328	0.722
	(2.5)	(2.1)	(2.4)	
Initial Likelihood			-1997.75	
Likelihood with Constants Only			-677.824	
Final Value of Likelihood			-537.47	

All the values in parenthesis are the T statistics of the coefficients.

TABLE 2 Estimation Results of the Multinomial Model

Variable		Change: Mode/Time	Change: Destination/ Cancellation	T ratio
Cancellation		-5.413 (-10.6)		
Change Destination		-5.00 (-9.8)		
Change Time		-5.604 (-12.0)		
Change to Transit		-5.928 (-11.1)		
Change to Special		-4.202 (-10.3)		
Payforpark	Workers	-0.5856 (-1.7)	-2.507 (-1.4)	-1.67
	Non Workers	-0.5548 (-2.6)	-1.051 (-5.1)	-2.20
Income	Workers	-0.1952 (-1.2)	-0.4766 (-1.3)	-0.739
	Non Workers	-0.1999 (-1.7)	-0.1751 (-1.5)	0.187
MissIncome		-0.8232 (-2.5)	-0.9819 (-2.7)	-0.39
Duration	Workers	-0.03 (-0.6)	-3.833 (-2.6)	-2.622
	Non Workers	-0.05566 (-0.6)	-0.2413 (-2.3)	-1.687
Hhsize		0.1277 (2.1)	0.0977 (1.6)	-0.427
Cost	Workers	0.1237 (2.1)	0.06764 (0.3)	-0.271
	Non Workers	0.2266 (4.9)	0.2365 (4.9)	0.187
Tsearch	Workers	0.1384 (4.9)	0.1654 (1.7)	1.405
	Non Workers	0.1749 (7.2)	0.1929 (7.8)	0.702
Ym		0.7865 (4.4)	-0.02834 (-0.1)	-3.83
Initial Likelihood		-2837.9		
Likelihood with Constants Only		-1382.72		
Final Value of Likelihood		-1202.68		

All the values in parenthesis are the T statistics of the coefficients.

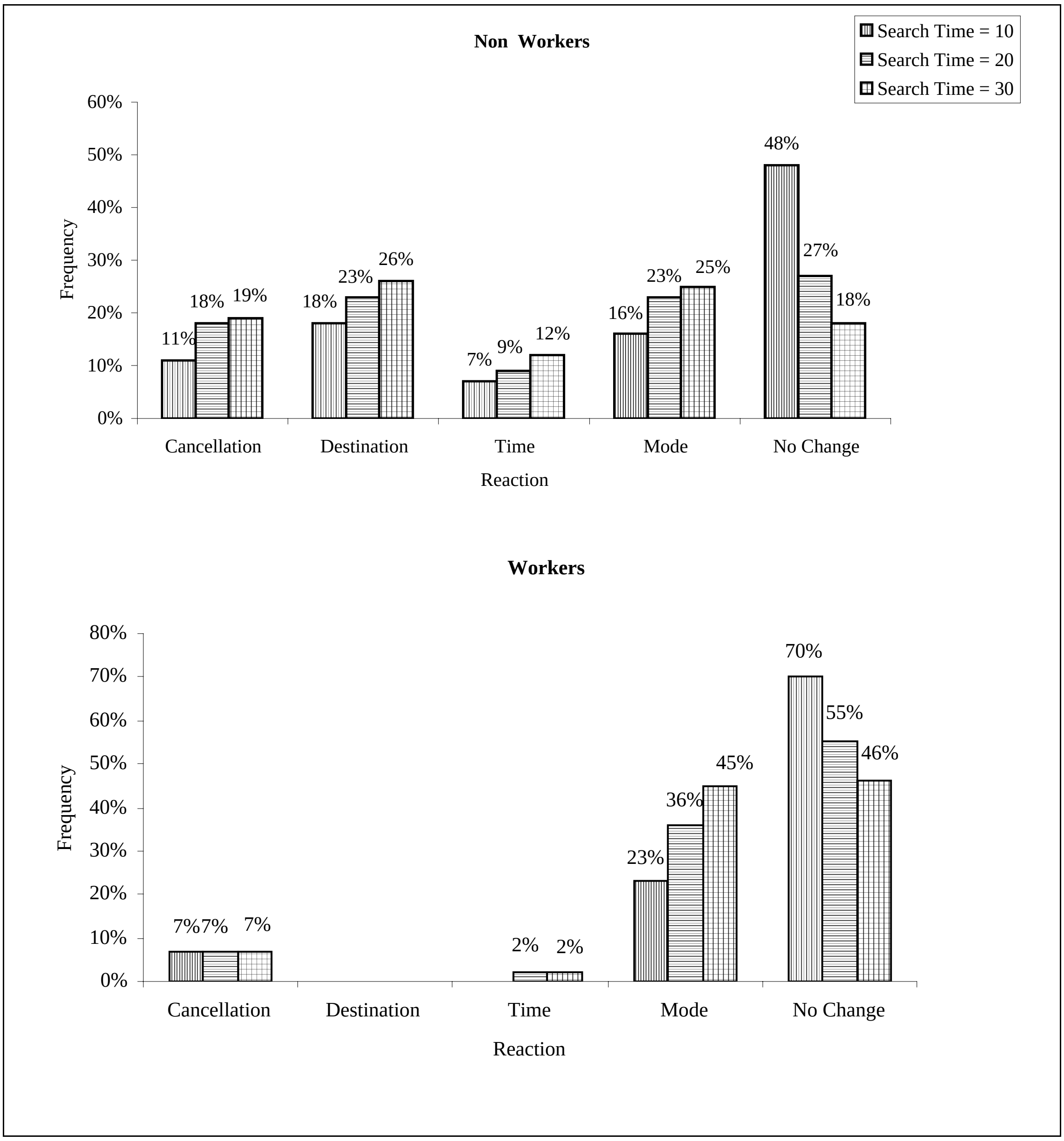


FIGURE 1 Stated Responses to increased Parking Search Time.

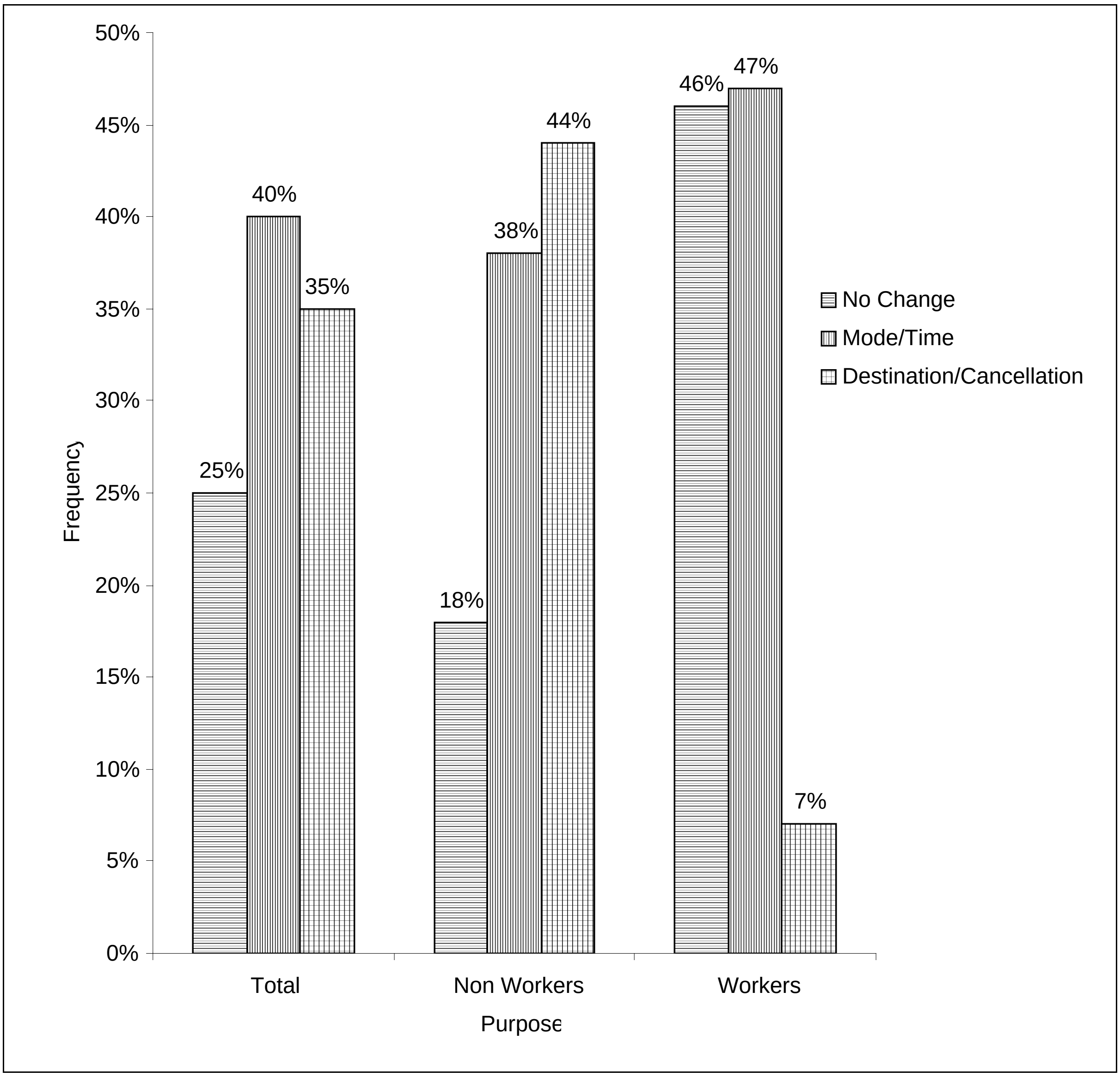
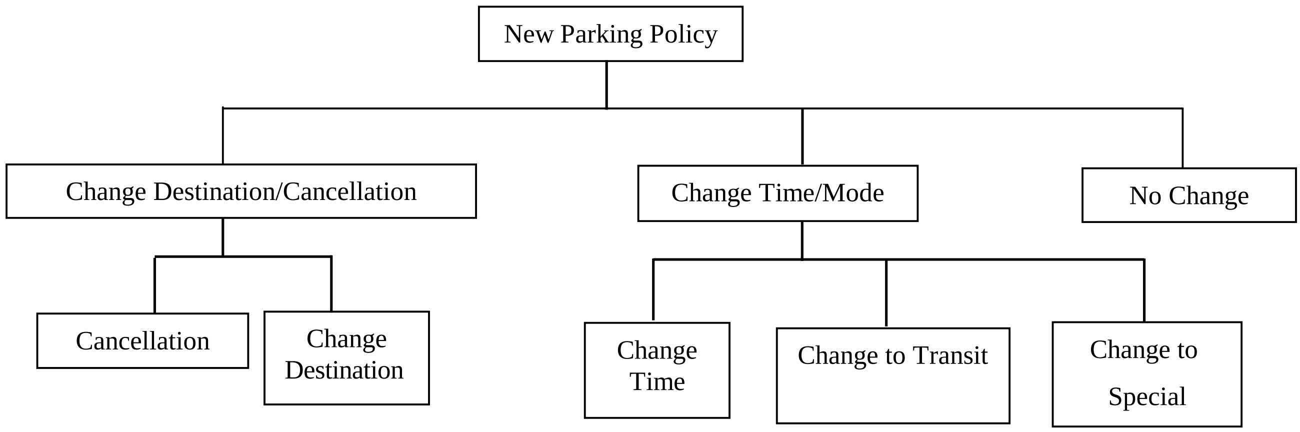
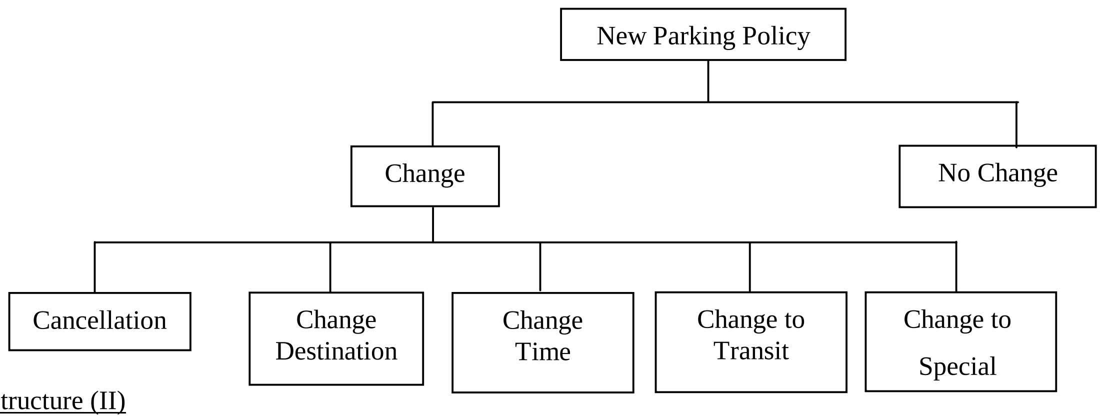


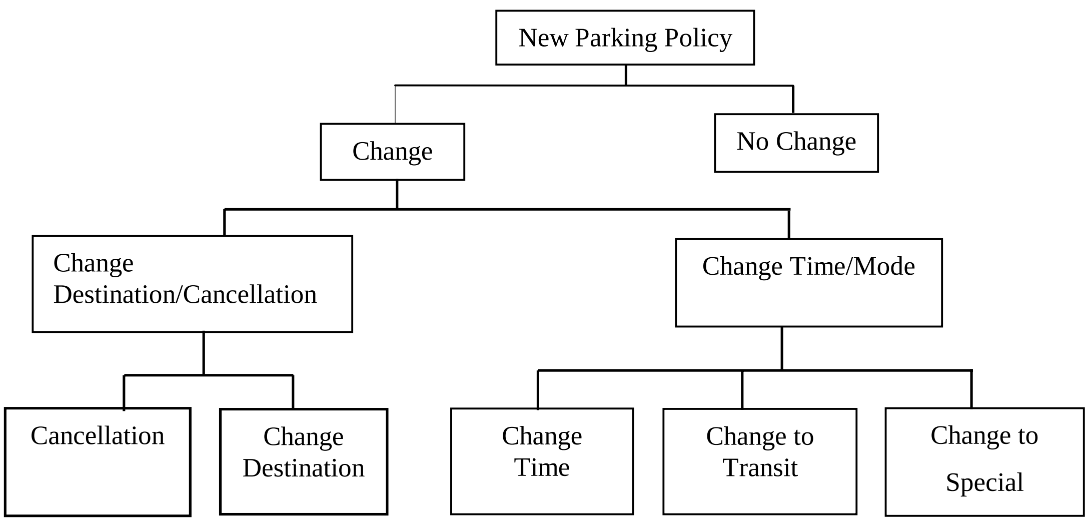
FIGURE 2 Stated Responses to 20 minutes Search Time.



Structure (I)



Structure (II)



Structure (III)

FIGURE 3 The Nested Logit Model Structures.

FIGURE 1 - Microsoft Excel

FIGURE 2 - Microsoft Excel

FIGURE 3 - Microsoft Word