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Regulatory parking policies at the firm level

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Abstract. This paper is focused on the intersection of two main policy 'tracks' followed in the Netherlands for the containment of road transport externalities: transport plans at the firm level, and regulatory parking policies. In this paper an applied modelling approach is taken, and the aim is to identify the relative importance of factors that are decisive for the viability of an individual firm's parking policies. The outcomes of an empirical survey conducted at the corporate level of the Free University in Amsterdam are used to discuss the social feasibility of regulatory parking policies conducted at the firm level (in terms of the employees' attitudes) and the effectiveness of such policies. Insight is provided into relevant backgrounds and obstacles serving to affect employees' commuting behaviour and that are likely to be encountered in the formulation of regulatory transport policies at the firm level. Moreover, the outcomes of this research may be relevant for the evaluation of regulatory parking policies at larger spatial scales (for example, neighbourhood parking schemes).

1 Introduction

Steadily growing levels of road use and of the associated negative external effects in terms of environmental pollution, noise annoyance, road safety, and congestion (for an overview, see Verhoef, 1994a) have created an increasing awareness among governments of the need to design policies aimed at coping with these unwarranted side effects of road transport. For the Netherlands, the most recent national policy plan in this context is the so-called Second Structure Scheme on Traffic and Transport, abbreviated in Dutch as SVV-II (TKSG, 1989 – 90), in which a rather broad and ambitious policy package for the transport sector is proposed. Although many of the announced plans have not yet been implemented or even initialized, some plans have materialized — at least to some extent.

One of the main pillars of the SVV-II report is the emphasis on regulatory parking policies as a means of reducing urban road traffic. According to the Dutch government, regulatory parking policies are an "indispensable part of an integral transport policy aiming at the reduction of the growth of road traffic" (TKSG, 1991 – 92, page 5, our translation). Accordingly, parking policies are now increasingly being used in many Dutch cities. Also, in other countries governments are increasingly recognizing the possibilities of parking policies as a means of reducing and reallocating (urban) road traffic (Barde and Button, 1990).

Also, in various recent academic writings on the regulation of road transport externalities the usage of parking policies as a second-best alternative to road pricing has received attention (for instance, see Arnott et al, 1991; Glazer and Niskanen, 1992; Verhoef et al, 1995a; 1995b). In these papers the second-best characteristics and theoretical drawbacks of parking policies as an alternative to road pricing in the regulation of road traffic congestion are studied from different theoretical perspectives (for instance, the nondiscriminatory character, problems with private parking

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space, spatial issues such as geographical scale and border effects, increased cruising, scheduling issues, and the timing of parking).

Others have focused on the impacts and effectiveness of parking policies with reference to empirical evidence. A number of these authors have investigated parking policies at the firm level (for overviews of experiences with employers' parking policies in the USA and Canada, and the impact on commuting behaviour, see Small, 1992; Willson and Shoup, 1990).

Only indirectly related to the regulation of road transport externalities are issues concerning parking choice (in terms of, for instance, type and location of parking, implied walking distances), which have been studied both on the basis of revealed preference techniques (Gillen, 1978; Kanafani and Lan, 1988; Van der Goot, 1982) and on the basis of stated preference techniques (Axhausen and Polak, 1991). These studies are usually focused on the (relative) valuations of, and trade-offs between, walking time, search costs, and parking fees. Last, following the introduction of electronic parking guidance systems in many cities, some research into their impacts on parking behaviour has recently been carried out (for instance, see Axhausen et al, 1994).

A second strategy (so-called 'track') in the Dutch SVV-II policy package, directed specifically at commuting behaviour, presupposes the active participation of firms. Firms with more than 50 employees are obliged to prepare so-called 'transport plans', in which a description should be given of the current commuting patterns of their employees, and initiatives must be launched to reduce the use of cars by employees for commuting.

In this paper we deal with both types of policy mentioned above. We will take as an empirical application parking policies at the firm level in the case of the Free University (FU) in Amsterdam, including its Academic Hospital. Within the context of a general survey conducted for the preparation of the transport plan for the FU, an additional survey on parking behaviour was held. The aim of this additional survey was twofold: (1) to assess the social feasibility (in terms of the employees' attitudes) of regulatory parking policies conducted at the firm level; and (2) to assess the effectiveness and viability of such a firm-based policy.

As far as we know the first topic has not yet been investigated in the context of (employers') parking policies. Still, it is evident that employees' attitudes are an important factor for the successful introduction and application of such policies. The social feasibility of regulatory policies is expected to be more dependent on the primary equity impacts than on the overall allocative efficiency of regulation (Verhoef, 1994b). As a matter of fact, the social feasibility of regulation has come to the forefront as one of the most important issues in recent transportation research — witness the many papers on the social feasibility of road pricing (for instance, see Emmerink et al, 1995; Giuliano, 1992; Lave, 1994; 1995; Verhoef, 1995). The second topic on the effectiveness of parking policies has been the subject of studies discussed elsewhere (Small, 1992; Willson and Shoup, 1990). However, these were studies from the USA and Canada, and — as will become clear — need not therefore be representative of the European situation.

In this paper we thus aim at providing insight into two main criteria for the evaluation of regulatory policies as discussed in an earlier paper (Verhoef et al, 1995c): social feasibility and the effectiveness of regulation. Hence, although the outcomes of the survey may to some extent be specific to the situation of the FU, the general issues considered certainly are not. The outcomes may in many respects be taken as illustrative for issues and obstacles to be encountered in the design of regulatory transport policies at the firm level aimed at the reduction of the use of

cars for commuting, for many firms at many locations. Moreover, the findings may also be relevant for the evaluation of regulatory policies at larger spatial scales (for example, neighbourhood parking schemes).

The paper has the following structure. The social feasibility of regulatory parking policies at the firm level will be discussed in section 2, where some general results are presented, and in section 3, which contains a more thorough statistical analysis of the attitudes towards such policies. The expected effectiveness of such regulatory parking policies will be discussed in section 4. In section 5 the possibility of a strategic bias in the response to the 'willingness to pay' questions is investigated. Finally, in section 6 we present our conclusions.

2 Employees' attitudes towards parking charges: some general results

In this section, some general results on the first central question in this research will be presented. This concerns the social acceptability of regulatory parking policies at the firm level. Before we turn to these results, it is useful to give some general background information on the survey.

The FU and its Academic Hospital are located side by side, near a residential area outside the city centre of Amsterdam. All employees at the university and the hospital (about 7800) received a questionnaire, the aim of which was to establish their current commuting behaviour and to get an insight into the possibilities of reducing the use of cars by employees for commuting. They were asked for their preferences on various alternatives (public transport, cycling, carpooling, etc) and on various aspects related to these alternatives (speed, financial costs, etc). The total response to the complete survey was 1773 (52%) for the Academic Hospital and 1803 (43%) for the FU, and hence 3582 (46%) in total. About 40% of the respondents usually use the car and 30% the bicycle in commuting. The remainder of the respondents used public transport or other modes of travel (walking, mopeds, etc).

Added to this general questionnaire was a parking survey, the outcomes of which are discussed in this paper. Of the 3582 respondents 3221 persons filled out this parking survey either partly (only the question related to attitudes) or completely. The parking survey started with four propositions concerning a possible charging of parking fees by the FU, including the Academic Hospital. This question will be discussed in this and the following section. The second part of the parking survey, which will be discussed thereafter, was directed to those respondents who sometimes (or always) use the car for commuting. They were asked where they usually park their cars, how much they are willing to pay for a parking place offered by the FU, and what they would do in the case that parking fees at the FU exceeded their maximum willingness to pay.

For the first question, four propositions were given, for which respondents could indicate whether they absolutely agreed, agreed, had no opinion, disagreed, or absolutely disagreed. This then resulted in a five-point scale of attitudes towards each of these propositions. The propositions are as follows:

Proposition A. I think it is a good idea for the Free University to charge for parking places: it costs money to supply parking space.

Proposition B. I think it is a good idea for the Free University to charge for parking places: the use of cars should be discouraged.

Proposition C. I think it is not a good idea for the Free University to charge for parking places: an employer is supposed to offer such facilities.

Proposition D. I think it is not a good idea for the Free University to charge for parking places: it is not a very sympathetic thing to do, and it might discourage visitors.

The response to these four propositions is given in figure 1. At first sight, the opinions seem quite evenly distributed. The first two propositions especially receive about as much support as opposition. However, proposition C receives more support than does proposition D. Apparently, people do admit that they let their own interests prevail over others' interests. Last, it may be noted that the issue as such is generally believed to be of sufficient importance on which to formulate a clear opinion: for each of the propositions, the 'no opinion' option has the lowest score.

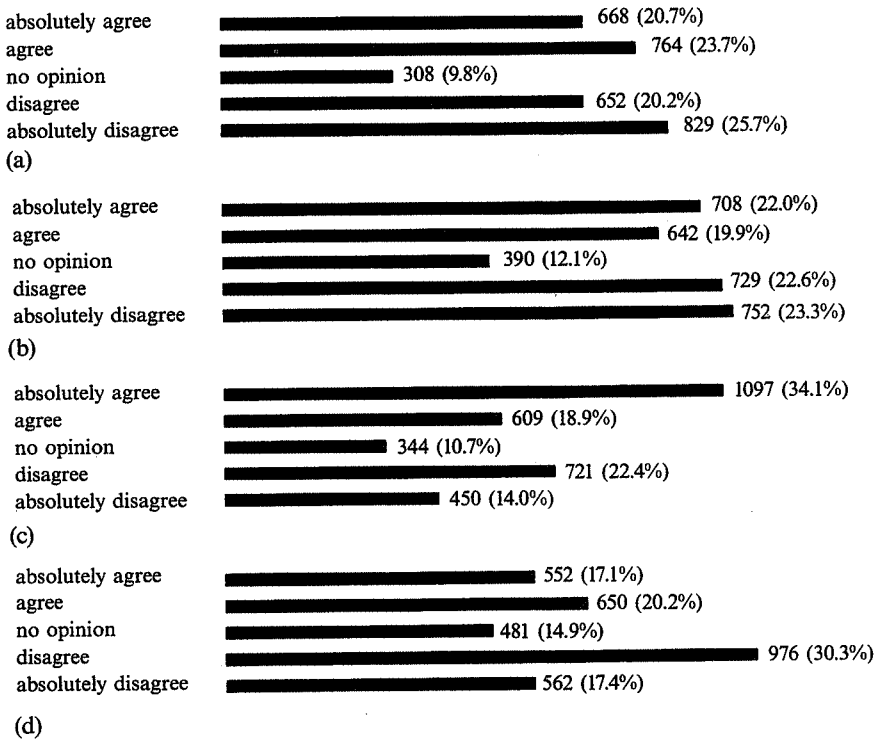

Figure 1. Attitudes towards the charging of parking levies by the Free University (including the Academic Hospital), Amsterdam, as measured by the responses to (a) proposition A (levies are a good idea; parking places cost money), (b) proposition B (levies are a good idea; use of cars should be discouraged), (c) proposition C (levies are a bad idea; employers should provide such services free of charge), and (d) proposition D (levies are a bad idea; it would be unsympathetic and may discourage visitors) (source: authors' survey).

In table 1 the rank correlations between the responses to these four propositions are given. It is clear that the responses are strongly correlated. This indicates that respondents are often consistently either in favour of or opposed to parking policies. However, the response to proposition D (the impact on visitors) is less strongly correlated to the responses to the other propositions.

To obtain some insight into the general attitude towards the charging of parking levies by the FU the scores on each of the four propositions were assigned values from 1 (absolutely agree) to 5 (absolutely disagree). By adding the scores for A and B, and subtracting those for C and D, a 17-point scale is created. A value of -8 indicates an extreme preference for the levying of parking charges, whereas a value of 8 indicates extreme opposition to the levying of parking charges. Of course, this procedure has some theoretical drawbacks. First, the scores measured on the four questions are of an ordinal rather than a cardinal nature, implying by definition that

in principle they cannot be added. Second, this procedure ignores possible arguments in favour of or against parking levies that have not been asked in the survey. Notwithstanding these drawbacks, the procedure yields a convenient summary statistic, which, if handled with caution, may be expected to reflect the general attitude towards parking charges in a sufficiently accurate way. Also, the high rank correlations in table 1 support to some extent the assumption of the existence of a general attitude towards parking policies.

Table 1. The rank correlations of attitudes to propositions A–D: Kendall's τ values (t-values are given in parentheses). The propositions are given in full in the text.

Proposition	Proposition		
	B	C	D
A	0.59 (51.49)	−0.67 (−65.03)	−0.27 (−17.86)
B		−0.58 (−51.59)	−0.21 (−13.86)
C			0.25 (16.38)

In figure 2 we give the distribution of the general attitude, which is again remarkably evenly distributed: the median value is at the attitude of 0 (implying indifference towards the levying of parking charges). The peaks in figure 2 are presumably because people are inclined to indicate either extreme or moderate attitudes.

The seemingly even distribution in figure 2 is disturbed quite drastically when the respondents are classified along relevant distinct criteria. In figure 3 the respondents are divided into two groups: those who most often use the car for commuting (regular car users), and those who most often use alternative transport, such as public transport or bicycles. Figure 3 clearly demonstrates that respondents usually commuting by car are generally opposed to the use of parking charges, whereas the opposite holds for those usually commuting by alternative transport modes.

Of course, there is nothing unexpected about this result. However, it is in some respects revealing. When the social feasibility of regulation of road transport externalities is considered, attention is usually focused on (certain groups of) road users.

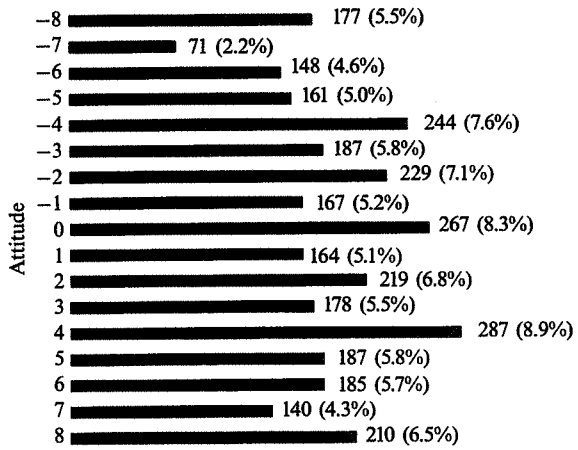

Figure 2. General attitude towards the charging of parking levies by the Free University (including at the Academic Hospital), Amsterdam, in terms of agreement with levies (increasing with increasing negativity of attitude score) and opposition to levies [increasing with increasing (positive) attitude score] (source: authors' survey).

Of course, this is an important issue. Moreover, when studying the regulation of an intrasectoral externality such as congestion, it is likely to be sufficient to study road users' attitudes only, as the benefits and the costs of such policies will generally remain within the population of road users (although this need not hold for the allocation of contingent regulatory tax revenues). However, as far as the regulation of environmental externalities is concerned, consideration of merely road users' attitudes may indeed give an overly pessimistic view of the social feasibility of such policies. This implies in the first place that a government wishing to assess a society's demand for environmental regulation may underestimate the benefits that other groups may derive from environmental policies. These other groups certainly need not be indifferent. Second, the overall social feasibility of environmental regulation may certainly benefit from making the public at large aware of the favourable impacts of such policies, hence creating a larger social momentum for environmental regulation.

Apparently, the respondents' mode of transport is an important explanatory variable for their attitudes towards parking charges; but, presumably, it is not the only relevant variable. In order to get a clearer picture of the underlying factors determining the attitudes towards such policies, we will now turn to a discussion of a more refined statistical model designed for this purpose.

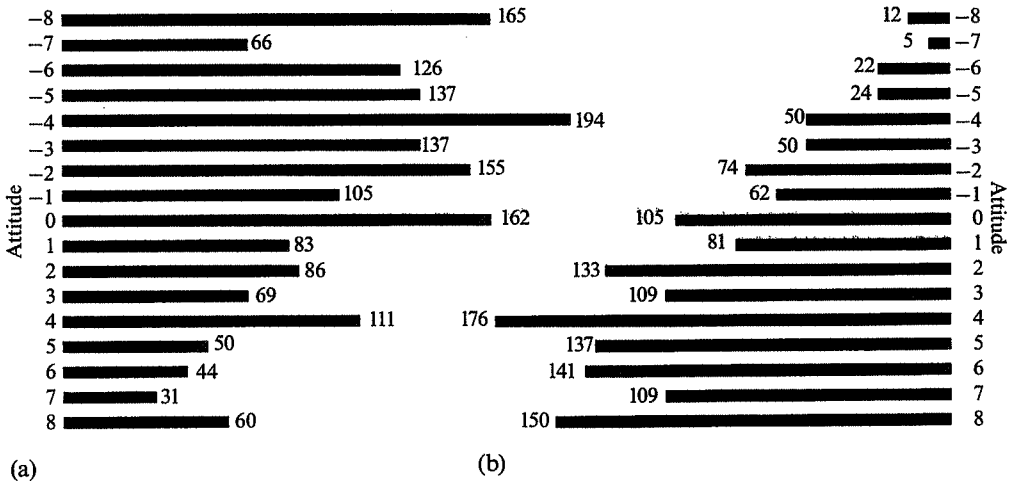

Figure 3. General attitude towards the charging of parking levies by the Free University (including the Academic Hospital), Amsterdam, in terms of agreement with levies (increasing with increasing negativity of attitude score) and opposition to levies [increasing with increasing (positive) attitude score]: (a) users of alternative transport modes compared with (b) regular car users (source: authors' survey).

3 Employees' attitudes towards parking charges: a multinomial ordered probit analysis

A statistical analysis of 'soft' data such as attitudes towards a certain policy is not, because of the subjectivity of the data, a very easy task. An additional problem in the present study is that we have no observations on a number of individual characteristics that may be relevant as explanatory factors of the attitudes studied (such as age, gender, type of job, income, or number of years employed). Still, we are able to make some interesting observations by means of statistical analysis. This is particularly important because it enables us to identify the characteristics that cause a commuter to be more, or less, opposed to parking policies. This information on

attitudes, in turn, although perhaps not readily translatable into actual behaviour, may help an employer in deciding whether to use parking policies, and, if so, to introduce parking policies in such a way that the resistance among employees is minimized.

A suitable statistical tool for analyzing the response to propositions A–D is the multinomial ordered probit model. This model does justice to the fact that the response can take on only discrete values and, to the fact that the response is an ordinal (not a cardinal) variable. The analytical details of this model are given in Maddala (1983). In short, use of the model is aimed at identifying the impact (and significance) of a number of explanatory variables on a dependent variable (here, the response to the attitudinal questions), and yields parameter estimates (β) as any other regression. A specific characteristic is that instead of a single constant a number of constants (α) are used which define the various categories to which the underlying response variable is assigned in the estimation procedure.

In our investigation we wish to determine the impact of eight variables on the attitudes to the four propositions, as follows:

variable 1 (car availability): the measure of whether or not the respondent has a car at her or his disposal for commuting;

variable 2 (regular car user): the measure of whether or not the respondent is a regular car user when commuting;

variable 3 (distance): the physical distance between home and work (measured in road kilometres);

variable 4 (travel time ratio): the ratio of travel time by public transport to travel time by road transport;

variable 5 (number of working days): the number of days per week the respondent works at the Free University;

variable 6 (parking problem): the measure of whether or not the respondent indicated that she or he sees parking as a major problem;

variable 7 (parking place): the measure of whether or not the respondent currently uses a parking place provided by the employer (the University);

variable 8 (university or elsewhere): two dummy variables which distinguish employees at the University and elsewhere from those in the reference groups working at the Hospital.

Except for variables (3)–(5), each of these are dummy variables, with a value of 1 denoting a confirmational response.

Variables 1 and 2 capture the respondents' 'car-mindedness'. Variables 3 and 4 indicate to what extent respondents are (or think they are) dependent on the car for their commuting. Variables 5–7 capture the extent to which the respondents are dependent on the FU's parking policy. For each of the variables, we expect a negative relation between its value and the extent to which a respondent agrees with the use of parking fees (except for the university and elsewhere dummies, for which there is no a priori expectation). Hence, we expect a positive β for the 'good idea' propositions (A and B) and a negative β for the 'bad idea' propositions (C and D).

Clearly, most of the above-mentioned variables will have a (potential) impact on the attitudes only if the respondent is a 'choice commuter'; that is, if he or she can choose between the car and alternative transport modes for commuting. Therefore, we estimated the multinomial ordered probit model only for those respondents who do have a car at their disposal for the morning commute and for whom variable 1 (car availability) is therefore equal to 1. In order to show the impact of this dummy, we report here that the difference between the average attitude of the 2209 respondents with a car at their disposal and that of the 938 others is 0.87 (3.33–2.46) for

proposition A, 1.16 (3.41–2.25) for proposition B, −0.90 (2.36–3.26) for proposition C, and −0.25 (3.03–3.28) for proposition D. These differences conform to our expectations, and the *t*-tests have shown that each of these differences are significant at the 0.001 level.

A complication for the statistical analysis of the choice travellers' attitudes is caused by the regular car user dummy, which was shown to be an important explanatory variable for the attitudes displayed in figure 3. When including this variable in the estimation, one has to take account of the possibility that it might 'absorb' some of the explanatory power of other independent variables, such as distance or travel time ratio, because of the expected impact of these variables on modal choice itself. In order to be able to check whether this is the case, a simple logit model was estimated first, to identify the impact of the other explanatory variables on the regular car user dummy.

In figure 4 the full recursive model is depicted. The black arrows represent the multinomial ordered probit analysis of the choice travellers' attitudes towards parking policies. The shaded arrow represents the additional logit analysis, the results of which might help in understanding the explanatory power of the various variables in the ordered probit estimation. It is perhaps of importance to stress here that we did not estimate a simultaneous model, as on theoretical grounds it is unlikely that the attitudes to parking policies would have an impact on current modal choice (that is, the choice of being a regular car user or not).

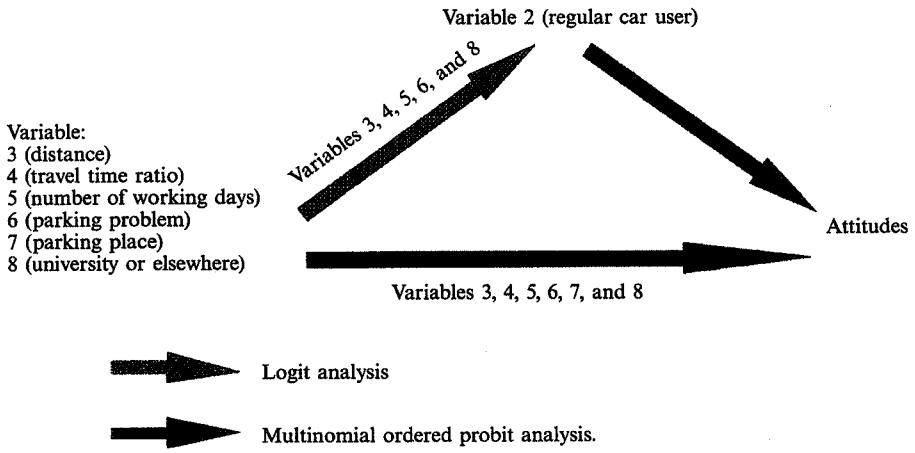

Figure 4. The full recursive model for the attitudes of choice commuters (those able to choose between taking the car or one other mode of transport to work) towards parking policies. Note: for a full description of the variables, see text.

The results of the logit estimation are given in table 2. It turns out that, apart from the university and elsewhere dummies, it is in particular the travel time ratio that is a significant factor in explaining why FU employees become regular car users in commuting. Furthermore, respondents who see parking as a problem when commuting by car are significantly less likely to be regular car users. Both findings conform to expectations. Distance as such is an insignificant explanatory factor in this estimation, because there are relatively few regular car users who travel comparatively short or long distances compared with those who cycle or take the train, respectively. (The parking place dummy was not included here, as the causality of any significant correlation would be disputable.)

Table 2. Logit estimation of the choice in favour of commuting by car for those commuters who have a car at their disposal (source: authors' survey).

Variable	β	t-value	t-significance [a]
Distance	0.00	0.62	0.541
Travel time ratio	0.58	7.13	0.000**
Number of working days	−0.05	−1.08	0.281
Parking problem	−0.77	−7.80	0.000**
University	−1.10	−10.60	0.000**
Elsewhere	−0.43	−2.57	0.010*
Constant	0.43	1.39	0.166
Measure of fit:			
likelihood ratio χ^2 [b]		212.61 (0.0000)	
−2 log-likelihood, full model		2610.05	
−2 log-likelihood, restricted model		2822.66	
pseudo-R^2 statistic		0.08	

$n = 2\,209$.

[a] Two-sided test for significance of t.

[b] Significance given in parentheses.

* Significant at the 0.05 level.

** Significant at the 0.01 level.

Note: for a full description of the variables, see text.

In table 3 the results are given for the multinomial ordered probit analysis of the choice commuters' response to the four propositions. As there are many results to discuss, we will give only a qualitative assessment of the impact of the independent variables on the attitudes, more or less in order of descending significance.

First and foremost, the question of whether the respondent is a regular car user turns out to be the most significant factor in the determination of the attitudes towards parking levies for propositions A–C, with the sign conforming to expectations. Moreover, the strongest discrepancy between the attitudes of regular car users and the attitudes of users of other modes of transport is found for the proposition that the use of cars should be discouraged (proposition B) indicating that there is little hope for a voluntary reduction in the use of cars for commuting.

Second, it is remarkable that for each of the four propositions there are significant differences between respondents working at the hospital (the reference group), the university, and elsewhere. For propositions A–C, those working at the hospital appear to be significantly more opposed to parking charges than are the rest of the respondents. However, in the case of proposition D (the impact on visitors), the hospital respondents are less opposed to parking charges than are the others. The general relative opposition to parking policies at the hospital (propositions A–C) most probably reflects that it is more difficult for employees at the hospital to find a parking place near their work location, partly because of the visitors to the hospital using the available space. This could then also be the reason for the smaller concern with the impact on visitors (proposition D) among hospital workers. The hospital attracts more visitors than does the university, which may cause its employees to feel more strongly about having to compete for scarce parking space with visitors than do employees at the university. If anything, these differences demonstrate that the attitude towards the type of measures considered may certainly vary from organization to organization, depending on more characteristics (which may be of a social, cultural, and, presumably, also organizational nature) than only those directly related to car-ownership and use. In addition to the differences in attitudes, it can be seen

Table 3. Results of the multinomial ordered probit analysis of the attitude of choice consumers (those able to choose between taking the car or some other mode of transport to work) towards parking policies, for propositions A–D (source: authors' survey).

	Attitudes towards proposition A			Attitudes towards proposition B		
	β	t-value	t-significance [a]	β	t-value	t-significance [a]
Regular car user	0.743	14.08	0.000**	1.053	20.18	0.000**
Distance	0.002	2.36	0.018*	0.004	4.03	0.000**
Travel time ratio	0.012	0.29	0.770	−0.007	−0.17	0.867
No. of working days	0.052	1.92	0.055	0.062	2.33	0.020*
Parking problem	0.174	3.54	0.000**	0.103	2.10	0.036*
Parking place	−0.017	−0.28	0.782	0.051	0.80	0.423
University	−0.408	−7.54	0.000**	−0.406	−7.53	0.000**
Elsewhere	−0.261	−3.14	0.002**	−0.219	−2.73	0.006**
Constant: [b]						
α_1	−0.441	−2.62	0.009	−0.436	−2.62	0.009
α_2	0.336	2.00	0.046	0.359	2.18	0.029
α_3	0.557	3.31	0.001	0.740	4.49	0.000
α_4	1.206	7.10	0.000	1.544	9.24	0.000
Measure of fit:						
likelihood ratio χ^2 [c]		350.40 (0.0000)			576.20 (0.0000)	
−2 log-likelihood, full model		6 138.53			6 013.20	
−2 log-likelihood, restricted nodel		6 848.93			6 589.40	
pseudo–R^2		0.05			0.09	

	Attitudes towards proposition C			Attitudes towards proposition D		
	β	t-value	t-significance [a]	β	t-value	t-significance [a]
Regular car user	−0.756	−14.13	0.000**	−0.199	−3.88	0.000**
Distance	−0.004	−3.53	0.000**	−0.000	−0.42	0.673
Travel time ratio	−0.003	−0.07	0.941	−0.031	−0.80	0.424
No. of working days	−0.059	−2.14	0.032*	−0.084	−3.38	0.001**
Parking problem	−0.166	−3.34	0.001**	0.015	0.32	0.752
Parking place	−0.091	−1.38	0.166	0.062	0.98	0.326**
University	0.588	10.65	0.000**	−0.335	−6.32	0.000**
Elsewhere	0.356	4.25	0.000**	−0.290	−3.52	0.000**
Constant: [b]						
α_1	−0.925	−5.45	0.000	−1.606	−10.03	0.000
α_2	−0.324	−1.92	0.055	−0.962	−6.10	0.000
α_3	−0.056	−0.33	0.739	−0.596	−3.79	0.000
α_4	0.799	4.70	0.000	0.334	2.11	0.035
Measure of fit:						
likelihood ratio χ^2 [c]		436.95 (0.0000)			60.74 (0.0000)	
−2 log-likelihood, full model		5 735.75			6 618.77	
−2 log-likelihood, restricted nodel		6 172.70			6 679.51	
pseudo–R^2		0.07			0.01	

$n = 2128$

[a] Two-sided test for significance of t.

[b] For details of these constants, see Maddala (1983).

[c] Significance given in parentheses.

* Significant at the 0.05 level. ** Significant at the 0.01 level.

from table 2 that employees at the hospital are more inclined to be regular car users than are the others.

Next, the travel distance is significant—and has the expected sign—for propositions A–C. The same holds, for each of the propositions, for the respondents' number of working days. Given the statistical insignificance of these variables in the logit model, it turns out that they have a direct impact only on the attitudes towards parking policies, and no significant impact on modal choice. The travel time ratio, in contrast, is not significant in any of the cases (estimations without inclusion of the travel time ratio yield practically identical results for the remaining variables, with the same overall fit for each of the propositions). Apparently, the relative advantage of car use compared with public transport is already fully captured by its impact on modal choice (see table 2) and has no additional effect on the attitudes.

The dummy variable parking problem is significant (with the sign in accordance with prior expectation) for propositions A–C. This reflects that those who face difficulties finding a parking place in the morning commute are quite reluctant to pay for such a parking place, presumably because they feel they already face time costs in the process of getting their cars parked. We will get back to this issue in more detail in section 5. In addition, the logistic regression shows that people who see parking as a problem in commuting by car are less inclined to be regular car users (see table 2). It is remarkable that this dummy is completely insignificant for proposition D. Apparently, these respondents are concerned with their own difficulties of finding a parking place and do not distinguish themselves at all from other respondents when it comes to the impact of parking charges on the FU's visitors. Surprisingly, the dummy representing the current usage of a parking place offered by the FU has no significant impact, and in two cases (propositions A and D) even has the 'wrong' sign.

Last, when comparing the measures of goodness of fit, it turns out that the response to proposition B (use of cars should be reduced) produces the best results, whereas the response to proposition D (impact on visitors) is the most difficult to explain statistically. For each of the four propositions, the likelihood ratios indicate that the estimated models do make sense. As we are interested mainly in the impacts of the respective explanatory variables, we will not go into any further discussion of the overall measures of fit.[1]

In summary, we found in the first place that respondents who do have a car at their disposal for commuting are more opposed to parking policies than are others. Next, for these choice commuters, the most significant explanatory variable for their attitudes towards parking policies is the regular car user dummy. Distance and the number of working days are also significant factors, whereas they are not significant in determining whether the choice commuter becomes a regular car user. The opposite holds for travel time ratio, where the contingent impact on attitudes is fully captured by its effect on modal choice. The parking problem, university, and elsewhere dummies are significant factors in both estimations, showing that, apart from their impact via modal choice, they have additional explanatory power for the attitudes.

Therefore, from the viewpoint of feasibility of regulation, a quite pessimistic picture emerges: those commuters who are responsible for the highest numbers of car kilometres per week (regular car users, located relatively far away, and commuting

[1] Neither do we discuss the α-coefficients. These are constants added to the model to take care of the ordinal nature of the dependent variable (for details, see Maddala, 1983). Note that in all cases $\alpha_1 < \alpha_2 < \alpha_3 < \alpha_4$.

relatively many times a week) have the strongest opposition to parking charges at the FU. In order to assess whether it is still worthwhile to pursue such policies, we will now turn to a discussion of the expected effectiveness of regulatory parking policies at the FU.

4 The effectiveness of regulatory parking policies at the Free University, Amsterdam

In this section, we address the potential effectiveness of regulatory parking policies conducted by the FU in order to reduce the use of cars by its employees for commuting. Apart from the social feasibility, this is a second major criterion for the evaluation of regulatory policies. For this purpose respondents who do at least sometimes use the car in the morning commute were asked for their maximum willingness to pay (WTP) for a parking place offered by the FU, assuming that no restitution is possible. A simple payment card method was used, with prices ranging from Fl 0.00 to Fl 25.00 or more per working day (see figure 5 for the exact values used).[2] In addition, respondents were asked to indicate their expected response (in terms of their second-choice alternative) to parking fees exceeding their WTP. This question was completed by 2116 respondents.

In figure 5 the unweighted cumulative response is shown. For each parking fee (along the horizontal axis) the curve labelled 'total' gives the number of respondents for whom that fee is equal to or larger than the maximum WTP indicated on the payment card. Hence, if each of the 2116 respondents is present at the FU on a certain day, an anticlockwise 90° rotation of this upper curve would give (after replacing the values along the vertical axis of figure 5, y, by $2116 - y$) the inverse demand curve for parking places offered by the FU. [We will postpone the issue of biased WTP response to section 5. In that section, in figure 6, such a transformation is depicted for the demand for parking places per week (which is a more meaningful base for a demand curve than the unweighted response).] The upper curve in figure 5 thus gives

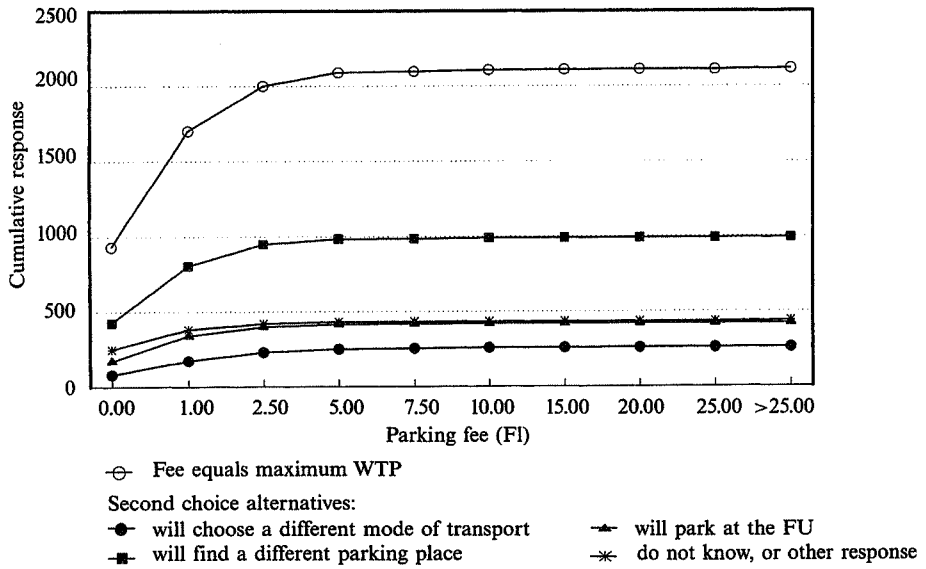

Figure 5. Cumulative maximum willingness to pay (WTP) per working day for a parking place offered by the Free University (FU; including the Academic Hospital), Amsterdam, and second-choice alternatives for the case where the parking levy exceeds the maximum WTP for the total, unweighted, population (source: authors' survey).

[2] The exchange rate of the Dutch guilder (Fl) is Fl 2.06 = 1 ECU.

an indication of the monetary value of the respondents' surpluses derived from commuting by car and parking at the FU for free instead of choosing their second-choice alternatives, as the derived demand curve for parking places is simply the demand for trips minus the marginal private costs for travelling, hence representing consumers' surplus in the case where parking costs are equal to zero (Verhoef et al, 1995a).

The nature of the second-choice alternatives is given in the other curves in figure 5. The shares of the four options distinguished remain rather constant along the horizontal axis. About 50% of the respondents indicate that they will look for a different parking place in the neighbourhood of the FU when the parking fee exceeds their WTP. Given the location of the FU, near a large residential area, a considerable share of these respondents will, presumably, indeed succeed in finding a parking place in the area around the FU. Only 12% of the respondents will choose an alternative transport mode (usually cycling or public transport). The other 40% is evenly distributed among those who do not know yet what to do in such a case and those who will park their car at the parking facilities of the FU despite the excessive price. These last respondents either have a WTP which is very carefully chosen between two values given on the payment card or did not understand the question correctly: they apparently have a WTP higher than that which they indicated on the payment card.

The results in figure 5 cast serious doubt on the effectiveness of regulatory parking policies at the FU. The picture becomes even more dramatic when one considers the impact of parking fees on car mobility, measured in weekly vehicle kilometres. When considering the regular car users only, and after weighting their response by the number of working days at the FU and twice the commuting distance (to account for round trips), it turns out that only 3.5% of the affected regular vehicle kilometres will be diverted to alternative transport modes. About 50% of the affected regular vehicle kilometres is generated by respondents who will look for a different parking place.[3] As far as the remaining regular vehicle kilometres are concerned (the categories 'will park at the FU' and 'do not know yet, or other'), we do not know the (intended) reaction to prohibitive parking fees. After proportionally dividing these respondents among the two ultimate options, we find that 93.5% of the affected regular vehicle kilometres will be diverted to different parking places, and 6.5% to alternative transport modes, including carpooling. These figures are quite insensitive to the value of the parking fee considered. This 'relative effectiveness' of 6.5% is very low, and this is a direct consequence of the fact that the policy is easily avoided by choosing another parking place. It may be noted that an unavoidable financial incentive by the FU (such as relative reductions of commuting allowances for solo car users, and allowances for carpoolers and public transport users) would have a much higher relative effectiveness in affecting the number of vehicle kilometres.

As noted before, the WTP response can be used to derive various demand relations. An important summary statistic associated with demand relations is the elasticity of demand, η, defined as the percentage change in demand (N) arising from a 1% change in price, P:

$$\eta = \frac{\partial N}{\partial P}\frac{P}{N}.$$

The elasticity of demand is usually specific to the particular point of the demand curve that is evaluated. For instance, for a constant-slope (linear) demand function,

[3] The extent to which the associated search processes in themselves will subsequently lead to more vehicle kilometres is then, of course, an interesting side issue, but it is difficult to consider without major speculation given the available information.

demand elasticity runs from zero at the intercept with the horizontal axis (*N*) to minus infinity at the intercept with the vertical axis (*P*).

In table 4 the elasticities of demand implied by the WTP response is given for a number of demand relations, evaluated at the parking fee level of Fl 1.00. The first numerical column gives the elasticities of the 'demand curve' based on the unweighted data, and the second column after weighting by the number of working days, thus giving the weekly demand for parking places at the FU. Both for total demand and for the three subgroups distinguished, it turns out that demand is more elastic after weighting by the number of working days. This is plausible, as it merely indicates that more frequent commuters would respond more strongly to price changes than would others.

Turning to the subdivision in user groups, those who have indicated they would switch to alternative transport modes have the most inelastic demand, followed by those who will seek a different parking spot, and, finally, by those who belong to the joint-rest category for which the second choice is not known (do not know yet, other, or will park at the FU). This suggests that the switch to alternative transport, even when it is preferred to seeking another parking place as a second alternative, is considered a more difficult one (requiring a larger financial incentive) than the switch to another parking place. The elasticities for the joint-rest group can presumably be explained by the fact that these respondents did not seriously consider the alternative choice they would have to make, hence overstating their elasticity of demand.

As the group that will choose alternative transport is relatively small, it should be no surprise that the demand for car trips with respect to parking charges, in the fourth numerical column of table 4, is quite inelastic (to derive this elasticity, the joint-rest category for which the second choice is not known is again proportionally divided among those who will choose alternative transport and those will find an alternative parking place). Even more inelastic is the demand for vehicle kilometres with respect to parking charges, in the sixth numerical column, which is in accordance with the findings for attitudes discussed in the previous section.

Table 4. Demand elasticities implied by the willingness to pay (WTP) per day for parking at the Free University (FU); including the Academic Hospital), Amsterdam, for a parking fee of Fl 1.00, as expressed by car-using employees. The subgroups represent the responses of employees to their WTP being exceeded (source: authors' survey).

	Overall demand (uuwgt.)	Demand for parking places at FU		Demand for car trips		Demand for vehicle kilometres	
		uncorr.	corr.[a]	uncorr.	corr.[a]	uncorr.	corr.[a]
All respondents	−1.156	−2.111	−2.055	−0.027	−0.037	−0.018	−0.029
Subgroup choice:							
alternative transport	−0.737	−1.909	−1.759				
alternative parking	−1.255	−2.035	−1.798				
other[b]	−1.321	−2.240	−2.386				

[a] Corrected for strategic bias (see section 5).

[b] Will continue to park at the FU, do not know yet, or other.

unwgt., unweighted; corr. corrected for strategic bias.

The elasticities for the demand for car trips and vehicle kilometres (uncorrected; see the fourth and sixth numerical columns of table 4) paint a far less favourable picture than do those in the studies reviewed by Willson and Shoup (1990), which range from −0.1 to −0.68 for the demand for car trips. There is a number of potential reasons for this discrepancy. The most important one is undoubtedly related to neighbourhood parking. As this phenomenon is only briefly mentioned by Willson and Shoup it is presumably not a relevant option for the case studies reviewed in their paper. Second, it may be hypothesized that some differences between the present case and the typical North American situation may play a role. For instance, whereas in the studies reviewed by Willson and Shoup the single most important alternative is carpooling, only 0.6% of the FU employees mention this as their second alternative. This may be because of various specific circumstances, such as a relatively flexible working hours regime (at the university), and the relative attractiveness of other transport modes (public transport, cycling). Furthermore, it should be borne in mind that in the initial situation only 40% of the respondents are regular car commuters. Presumably, this figure is much higher in the typical North American situation. As a consequence, one might suspect that in the initial situation at the FU a considerable preselection process has already taken place, which causes the current group of regular car users to be those who indeed have a relatively strong need or desire to commute by car. Third, the elasticities may be biased because of strategic response. This possibility will be dealt with in the next section.

In summary, it does not seem to be a good idea to stimulate the intended shift in the modal split of the FU's employees from car to alternative transport by means of regulatory parking policies. Apart from a very modest reduction in vehicle kilometres, this will mainly result in a considerable shift of the 'parking burden' from the FU onto the surrounding area, with an expectedly negative impact on the FU's local image. Unless more stringent parking policies are implemented in the FU's neighbourhood, such a policy seems to provide no fruitful option. However, the fact that regulatory parking policies by the FU cannot be used as a 'stick' in affecting the employees' commuting behaviour does not, of course, imply that it could not be used as a 'carrot'. The most logical option in this respect — unfortunately not covered by our survey — seems to offer cheap, or free, and perhaps guaranteed parking places for carpoolers. As 44% of the regular car users indicated that they see parking as a major problem, such a measure may have some potential, especially as the practically unavoidable time loss associated with carpooling could in that way at least to some extent be compensated for.

5 An analysis of the willingness to pay for a parking place

WTP data such as those discussed above always contain some particular inherent unreliability, as they are not based on actual behaviour. At best, WTP data reflect intended market behaviour; however, the data may additionally be biased when respondents exhibit strategic behaviour. For instance, strategic responses can be expected when respondents foresee that the outcomes of the survey may be used in actual policy formulation. In the present context, this would lead respondents to give a low bid if they assume the FU will base its parking charges on the outcomes of our study. A specific form of biased bidding arises when respondents express their dislike of paying for the good in question by giving a very low WTP, which would lead to an additional downwards bias in the WTP estimates. This phenomenon is usually referred to as 'protest bidding'. In this section, we will investigate the plausibility of the WTP responses discussed in section 4. As the two sources of downwards bias in the WTP response just mentioned are hard or even impossible to

disentangle, the response will be tested for a general downwards strategic bias, which may be caused by protest bidding or by an attempt to make the employer set lower parking fees.

This exercise is interesting not simply for the primary reason of assessing the impact of a number of potential explanatory variables on the WTP for a parking place. In addition, it may give some indication of the role of strategic response and protest bidding in studies based on contingent valuation methods in general. Such methods are often used for the valuation of environmental amenities (for instance, see Hoevenagel, 1994; Mitchell and Carson, 1989). In contrast to many other studies, in the present survey we are able to compare the stated preference results with revealed preference data for a specific subset of the respondents.

In order to obtain some insight into the factors determining the WTP for a parking place, including the role of strategic bidding, the WTP responses were regressed on a number of potential explanatory variables. The strategic bidding effect was captured by including the general attitude (see figure 2) as one of the explanatory variables. Our hypothesis is that the impact of this general attitude on biased bidding is not symmetric. Whereas a strong opposition to parking charges may indeed cause respondents to mention a lower WTP than their true WTP, the opposite, of respondents boosting their true WTP because they agree with the instrument of parking charges, seems far less plausible. The reverse causality is more likely in these cases: the fact that one can afford a relatively high bid for a parking place may lead such respondents to be in favour of parking charges, because this might increase their chances of receiving a parking place for the money they are willing to pay for it. This, however, is not strategic bidding, as the bid then still reflects the true WTP. For this reason, the general attitude was rescaled to what will be called the 'opposition index'. This index is equal to the general attitude for values greater than or equal to zero, and is kept equal to zero for negative values of the general attitude. With ordinary least squares, the following relation was subsequently estimated for the regular car users (with two-sided t-statistics followed by t-significance given in parentheses below):[4]

$$\begin{aligned}\text{WTP} = &-0.166 \times \text{opposition index} + 0.001 \times \text{distance} + 0.052 \times \text{travel time ratio}\\ &\quad(-12.38,\ 0.000) \qquad (0.54;\ 0.590) \qquad (0.84;\ 0.403)\\ &-0.188 \times \text{number of working days} - 0.169 \times \text{parking problem}\\ &\quad(-4.63;\ 0.000) \qquad (-2.15;\ 0.032)\\ &+0.400 \times \text{university} + 0.298 \times \text{elsewhere} + 1.948\ ,\\ &\quad(4.75;\ 0.000) \qquad (2.30;\ 0.022)\ (7.62;\ 0.000)\end{aligned}$$

$R^2 = 0.16$.

This simple regression offers some surprising insights. First of all, the opposition index turns out to be a very important factor in the explanation of the stated preference WTP. The more one is opposed to parking policies, the lower the bid. This strongly suggests the presence of biased WTP responses.[5]

[4] A regression of the less attractive (from a theoretical point of view) model with the *general attitude* instead of the *opposition index* yields comparable results. The coefficient of the general attitude is somewhat lower (−0.153); the t-value rises to −15.89. The R^2-statistic increases to 0.21. The better statistical fit is presumably caused by correlation arising from the reversed causal relation described above in text with high-WTP respondents being in favour of parking charges because they expect to increase their chances of finding a parking place.

[5] It is, of course, not unambiguous whether the relation between the opposition index and the WTP is entirely a result of strategic bias. For the same reason mentioned in footnote 4 when explaining the choice for the opposition index instead of the full-range general attitude,

The idea of biased bidding is further supported by the sign (and significance) of the parking problem dummy. Respondents who have indicated that they face difficulties finding a parking place in the morning commute have a significantly lower WTP for a parking place. This, of course, is at odds with any economic logic, which would predict a higher WTP for a good with a higher value (a parking place, if one generally finds it hard to find such a place) than for a good with a lower value (a parking place if one generally finds it easy to find such a place). Apparently, the regular car user does not consider a parking place as a normal economic good. Rather, these results (together with those discussed in section 3) indicate that the regular car user, though needing a parking place for her or his commute, actually assumes the supply of parking space mainly to be the employer's responsibility and is not willing to pay (much) for its use.

Next, it may be noted that the impact of the variables distance and travel time ratio, although having the expected sign, is not significant in the determination of the WTP. The number of working days is significant and has a negative sign: the more often one is present at the FU, the less one is willing to pay, per working day, for a parking place. This is presumably a result of some budget effect. Unfortunately, we have no observations on incomes. However, the sign of this parameter suggests that the number of working days at the FU is related more to the question of whether respondents work at home or somewhere else on other working days than that it is related to overall income (in which case the sign of the parameter might also have been positive). Last, in line with the findings mentioned in section 3, the WTP is significantly lower for respondents at the hospital than for those working at the university and elsewhere.

It is clear that the R^2-statistic is not very high. An important reason for this is that an important explanatory variable, namely income, is not available. Moreover, as in section 3, we are, in particular, interested in the impact and significance of the various explanatory variables, not in the overall fit. It is in this respect also worth mentioning that the estimation of the model with the respondents subdivided according to the best alternative to parking at the FU did not yield any significantly better results. In other words, the WTP response does not vary with the second-choice alternative that respondents have in mind.

Apart from the regression discussed above, we have a second possibility of checking the WTP responses for strategic bidding. In particular, we are able to compare the WTP reported by respondents who have indicated that they usually park at a parking place at the FU with the prices actually charged. When the survey was held, these prices were Fl 2.50 per day, Fl 12.50 for a monthly ticket, and Fl 120.00 for a yearly ticket. The monthly and yearly tickets would, for full-time workers (working on average 20 days a month and 240 days a year), result in daily prices of Fl 0.63 and Fl 0.50, respectively. Logically speaking, then, respondents with a WTP of Fl 0.00 will not park at this parking place. However, it turns out that, among the 421 respondents regularly using these parking places, no less than 159 (38%) report a maximum WTP for a parking place of Fl 0.00. Clearly, also, this observation strongly suggests the presence of a strategic bias in the WTP responses.

(5) continued
here also the causality could actually be of the reverse nature. Then, a small budget would lead respondents to be able to make only a small bid, and the opposition against parking charges could then reflect the fear of being priced off the parking market. Then, the bid would reflect the true WTP and would not be biased because of protest bidding. However, given the generally low levels of the WTPs (see figure 4) and the fact that free parking space is available in the area around the FU, this does not seem to be very likely.

It is tempting to somehow try and correct the WTP responses for this strategic bidding bias. The most straightforward way of doing so is by adding a sum of 0.166 multiplied by the opposition index to the reported maximum WTP. In that case, the number of unexplainable parkers at the specific parking place decreases to 47 (11.2%), which is a significant improvement when compared with the 38% obtained with the uncorrected data. In table 4 the impacts of this correction on demand elasticities is given. For the demand for parking places the impact is a slight decrease of the demand elasticity. For the demand for car trips and vehicle kilometres, the elasticities with respect to parking charges increase.[6] Hence, this correction indeed boosts the elasticity of the demand for trips a bit further, to the order of magnitude mentioned by Willson and Shoup (1990), but the 'neighbourhood parking leak' remains considerable.

The regular car users' corrected and uncorrected demand curves for parking places at the FU are represented in figure 6. One should be cautious with the interpretation of these curves, not only because they are based on WTP data only, but also because the data are obtained in a context where car users are able to use alternative (free) parking places in the neighbourhood of the employer. Nevertheless, it is clearly interesting to confront these two curves with the cost of supplying parking places.

Given the heavily regulated nature of the land market, it is difficult to determine the actual value of land in the neighbourhood of the FU. In a recent publication of the Dutch government (TKSG, 1991–92), an average land value for parking space of

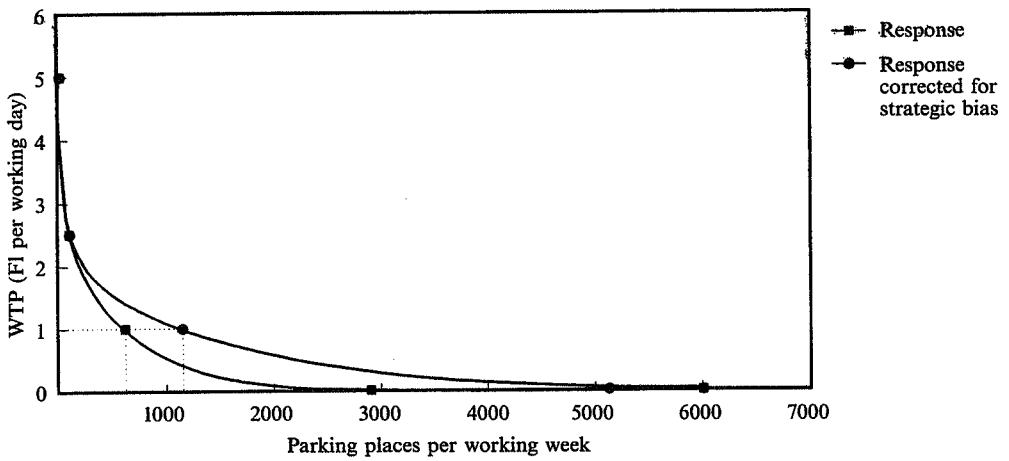

Figure 6. Demand curves for parking places at the Free University (FU; including the Academic Hospital), Amsterdam: the willingness to pay (WTP) of regular car users, and their WTP after a simple correction for a protest response (numbers are weighted by the number of working days) (source: authors' survey).

[6] The reader may wonder why the elasticities of demand for car trips and vehicle kilometres increase as a result of the correction whereas the elasticity of demand for parking places at the FU decreases. This has to do with the definition of demand elasticity. Each of the demand curves considered gets flatter at Fl 1.00 as a result of the correction, as the number of respondents with a zero WTP reduces after the correction (see, for instance, figure 6). However, for the elasticity of demand for parking places, this effect is dominated by the higher 'corrected' level of demand at Fl 1.00, leading to a smaller elasticity. For the demand for trips and vehicle kilometres, the relative decline in demand at Fl 1.00 arising from the correction is much smaller, and the impact of the flatter slope of the demand curve dominates.

Fl 250 m^{-2} for the Netherlands is used. The land used for a parking place of 12 m^2 would then represent a yearly value of Fl 240 (at an interest rate of 8%). With 240 working days a year, a daily price of about Fl 1 would compensate only for the land costs embodied in the parking place (therefore excluding costs of construction and maintenance). Presumably, in the area around the FU land values will be higher than the Dutch average. Still, even with this conservative estimate, only 10% of the 'average' (weighted with the number of working days) regular car users are willing to pay these implicit costs of their modal choice according to the uncorrected stated preference data. After the simple correction for strategic bidding outlined above, this percentage increases to about 18%.

Therefore, proper pricing of parking space in itself may already have a considerable impact on the respondents' modal split decisions, before any additional regulatory fee aiming at a reduction in car use is included in such levies. However, it is clear that the success of such policies will depend strongly on the question of whether such policies are conducted on a sufficiently large spatial scale.

6 Conclusions

In the foregoing analysis we have been concerned with the intersection of two main policy 'tracks' followed in the Netherlands for the containment of road transport externalities: transport plans at the firm level, and regulatory parking policies. Two main criteria for the evaluation of regulatory policies were addressed to the social feasibility and the effectiveness of regulation. The outcomes of a survey conducted at the Free University in Amsterdam were used to discuss the employees' attitudes towards regulatory parking policies conducted on the firm level, which is indicative of the social feasibility, as well as the effectiveness, of such a policy. In particular, the element of social feasibility of regulation has, over the past few years, come to the forefront as a very important, but often neglected, criterion for the evaluation of regulatory policies in transport policies. This study is, as far as we know, the first to address this issue in the context of regulatory parking policies.

The outcomes can in many respects be taken as illustrative for comparable issues and obstacles to be encountered in the formulation of firm policies aimed at reducing the use of cars in employees' commuting behaviour, for many organizations at many locations. Moreover, the outcomes may also be relevant for the evaluation of regulatory parking policies at larger spatial scales (for example, neighbourhood parking schemes).

Concerning the social feasibility of regulatory parking policies by the FU, it was found that, although the overall general attitudes are remarkably evenly distributed, regular car users are relatively strongly opposed to such measures, whereas the opposite holds for those usually commuting by alternative transport modes. Therefore, as far as the regulation of environmental externalities of motorized road transport is concerned, consideration of merely road users' attitudes may given an overly pessimistic view on the social feasibility of such policies.

In section 3 a more refined statistical analysis of the factors determining employees' attitudes was presented. Such an identification of characteristics that cause a commuter to be more, or less, opposed to parking policies may help an employer in deciding whether to use parking policies to affect employees' modal choice, and, if so, to introduce parking policies in such a way that the resistance among employees be minimized. A first finding was that respondents who do have a car at their disposal for commuting are more opposed to parking policies than are others. Current modal choice is the most significant variable in determining the choice commuters' attitudes towards parking policies. In addition, the recursive model of the attitudes revealed

that it is, in particular, the relative attractiveness of modes (travel time ratio, the perceived difficulties in finding a parking place) that determines modal choice, whereas absolute characteristics of commuting behaviour, such as distance and the number of working days, have additional explanatory power for the attitudes towards parking policies. Hence, the data strongly suggest that commuting behaviour can be diverted into more favourable directions by supplying good quality alternatives. This would often require policymaking at higher levels than the firm level (although in some instances firm transport services such as special shuttle buses could be envisaged). This would, in turn, have a favourable impact on the feasibility of regulation. The analysis further indicates that the attitude towards the type of measures considered may vary strongly between different organizations, depending on more characteristics (which may be of a social, cultural, and presumably also organizational nature) than just those directly related to car-ownership and the use of cars. An implication is that in some cases the social feasibility of regulatory transport policies at the firm level may be increased by adaptations in the organizational structure that could make behavioural changes by the employees more easy. The strongest discrepancy between regular car users' and the others' attitudes is found for the proposition that the use of cars should be discouraged. This leads us to the conclusion that there is little hope for a voluntary reduction of the use of cars in commuting and that stronger policies are therefore needed to realize a favourable change in the existing commuting patterns.

However, although parking policies at larger spatial scales may be an effective means for reducing the use of cars, it does not seem a good idea for an individual firm to engage in more stringent parking policies. Our data suggest that this will result in a considerable shift of the 'parking burden' from the firm onto the surrounding area, with an expectedly negative impact on the firm's local image. The implied demand elasticities of car trips and vehicle kilometres with respect to parking charges are, accordingly, very low. Also, for the design of parking policies at larger spatial scales (for example, neighbourhoods), careful account should be taken of the possibility of such spatial 'escapism' for parkers. Still, the fact that regulatory parking policies by the firm cannot be used as a 'stick' in affecting the employees' commuting behaviour does not, of course, imply that it could not be used as a 'carrot'. The most logical option in this respect seems to offer cheap, or free, and perhaps guaranteed parking places for carpoolers. As the majority of the regular car users indicated that they see parking as a major problem of using a car, such a measure may have some potential, especially as the practically inevitable time loss associated with carpooling might then at least to some extent be compensated for. Individual firms wishing to use financial incentives for affecting their employees' commuting behaviour should look for unavoidable measures; for instance, in the sphere of mode-specific commuting allowances (such as reductions in allowances for car users).

In section 5, we found evidence for a considerable strategic bias in the WTP response for a parking place, which necessitates a correction procedure before these data can be used. This underlines the care that should be taken when dealing with WTP data. Another important conclusion from the discussion in that section is that car users do not consider parking space as a normal economic good at all. They are, in general, opposed to the pricing of parking space; they also have a lower WTP when the actual value of a parking place is higher. A large majority of regular car users has a WTP for a parking place that even falls short of its conservatively estimated land value. The lesson that can be drawn from this is that individuals apparently need to be trained to regard economic goods from a scarcity perspective.

Given our finding that this is already the case for land use—which is actually priced in many other situations—this may certainly be expected to hold true for environmental amenities. As favourable voluntary adaptations in commuting behaviour are not very likely to materialize, it seems that such training is needed in policies aimed at a reduction of road transport externalities.

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