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A case study of parking charges at work places – effects on travel behaviour and acceptance

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Abstract

This paper analyse how a parking fee affect modes of transport on work travels and how acceptability varies over time among employees. The findings shows that the share of car drivers is reduced from 35 to 27 percent after the fee was introduced. There are weak tendencies towards spill-over parking and the fee has contributed to less need for employees to arrive early in order to secure a parking space. The acceptance for the parking fee changed from being negative before the fee to positive one year after the fee.

Keywords: Parking fee, acceptability, before-and-after study, travel behaviour

Background

Cities face urban challenges connected to environment and congestion. European Environmental Agency (EEA) states that up to a third of people living in cities are exposed to a pollution level that exceed the EU standards (EEA 2013:8) and congestion is a common feature for larger cities. Parking restrictions can be a necessary tool to fight such urban problems. Especially parking fees at work places can potentially have large effect on the mode choice for the journey to work. The majority of car drivers to work have free parking in Norway and six out of ten workers have free parking in Oslo (Hanssen and Christiansen 2013). Moreover, although congestion tolls are arguably more effective to reduce congestion and stimulate to off-peak travels, parking fees can be a second best option since work travels are usually bound in time and conducted at times when the demand is largest. Regulation of such parking can thus be an effective instrument for reducing pollution and congestion (Verhoef, et al. 1995). This article studies such effects of a parking fee introduced for employees at the Norwegian Public Road Administration. Marsden (2006) highlights the importance of conducting such studies since the evidence base for parking policies is underdeveloped.

There is also a lack of knowledge about acceptance of parking fees. This article investigate how acceptance towards parking fee evolves before, during and after a parking fee is introduced. The findings can help to understand why employers do not implement parking fees. The lessons learned from this case study can also be used to highlight strategies that can help increasing acceptability for other firms that considers introducing a parking fee.

Effects of parking fees on work places

All car trips starts and ends with parking. Parking can therefore be analysed in terms of e.g. commuting, location choice, residential parking, parking for commercial and leisure and organisation of parking. This section will focus on literature regarding work trips.

There is a growing literature on estimating effects of increasing parking costs. Shiftan and Golani (2005), Simocecic et al (2013) and Hess (2001) showed that workers react to increase in parking costs and that parking fees has significant influence on mode choice. Peng et al. (1996) argues that the effect on parking charges are dependent on where the commuters live. Suburban residents are less sensitive to parking charges. Ferguson (1999) argues that spill-over parking is more likely than switch to alternative modes of transport. Washbrook et al. (2006) concludes that increase in costs are more effective than increase in travel time for use of car or improvements in the transport system for other modes than car. Su and Zhou (2012) used a nested logit model and found that commuters decrease the rate of driving alone due to higher single- occupant vehicle (SOV) parking costs and higher discounts for high-occupancy vehicle (HOV). Rye et al. (2006) analyse on-street parking and choice of mode for work travels and argues that expansion of Controlled Parking Zone (CPZ) could contribute to a 21 percent reduction in private car use to work.

A common feature is that the literature mainly estimates effects through stated preferences or through "with and without" studies that compare mode of transport in an area that are similar in relevant aspects except parking. There are few before and after studies connected to parking fees. Wilson and Shoup (1990) reviewed empirical studies of the effects of parking fees for work travels. They refer to four before and after studies conducted in the late 70s and early 80s. The results shows a significant decrease in single car use.

Fearnley and Hanssen (2012) conducted a literature review and concluded that there is need for more knowledge about how price influence demand for parking. According to their study, the average elasticity was -0,21. According to Vaca and Kuzmuak (2005) employee parking elasticities lies between -0,1 and -0,3. Albert and Mahalel (2006) used stated preferences and found an elasticity on -1,2 for parking fees and that commuters are willing to pay more for parking fees compared to congestion tolls.

Based on the literature, the following hypotheses will be tested:

- Car use decreases with parking fee
- The effects of a parking fee will be offset by spill-over parking
- Parking fee influence start time for travels

Factors influencing acceptance

Lack of acceptance can be a major barrier for implementing effective strategies for a more effective and sustainable transport system. This is particularly evident when it comes to congestion pricing which for long has been advocated as an effective mean for reducing congestion and stimulate to less car use. However, few studies have analysed acceptance of parking fees at work places. This article will therefore extract findings from acceptance studies in general and study whether the same aspects are relevant connected to parking fees at work places.

One central hypotheses is that acceptability is likely to increase when the public has familiarity with a (restrictive) measure (Jones 2003). This means that a given restrictive measure could be introduced despite opposition since the acceptability will increase when the benefits are demonstrated. Edinburgh in Scotland did the opposite of such a strategy. The city had a referendum on introducing congestion charges without any trial period. Gaunt et al. (2007) found that the public had a limited understanding of the scheme and were sceptical of the effects. Car use was also a major factor explaining voting behaviour (ibid).

In Sweden, on the other hand, they had a referendum about congestion charge after first having a trial period. Schuitema et al. (2010) studied acceptance before and after the Stockholm congestion charge. They found that acceptance rose after the charge was implemented and, after the charge, respondents believed the instrument had more positive effects and less negative effects compared to before the congestion charge. Kallbekken and Sælen (2011) studied acceptance for environmental taxes. They concluded that there is no simple solution for increasing acceptance. Trust in how the government spend the revenue are one of the most important factors explaining acceptance.

Thus, the following hypotheses will be studied in this article:

- *Employees will be negative towards the fee before implementation, but positive after its introduction.*
- *Employees often using car to the journey to work will be most negative*
- *Earmarking of revenues will raise acceptance*

Research design

The case study - Norwegian Public Road Administration

Increased attention has been raised by the national government as to reducing car traffic (Norwegian Ministry of Environment, 2012; Norwegian Ministry of Transport and Communications, 2013, National Transport Plan 2013). The Norwegian Public Road Administration is responsible for developing an environmental friendly transport system and the organisation aspire to be a role model for other employers.

The Norwegian Public Road Administration (NPRA) has offered free parking for employees despite being localised in a central area with good provision of public transport and adequate infrastructure for walking and cycling. In September 2011, they introduced a parking fee for employees driving to work. Employees had to pay a daily fee of 25 kroner (approximately 3 Euros) for parking. The aim of the parking charge was to reduce car use among employees and stimulate to increased share of people walking, cycling or travel by public transport to work.

A vast amount of literature have documented how location influence mode choice for commuters (Næss 2012, Hartoft Nielsen 2001, Bäckström et al 2013, Engebretsen and Christiansen 2011, Christiansen and Julsrud 2014), how transport systems affect behaviour (Banister 2005) and how various means reduce car use (Fridstrøm and Alfsen 2014). NPRA is located about 3 kilometres from Oslo city centre. It is defined by Oslo municipality as a transport focal point. The area is characterised by a mix of housing, business and service. Persons travelling within Oslo or from suburban areas can in most cases use public transport directly through local and regional buses, metro and train. Car users need, in most cases, to pass toll cordons.

At the time of study, the NPRA had 602 employees and offered 143 (free) parking lots. A maximum of 24 per cent of the employees could use the provided parking facilities. There are limited possibilities to park free in neighbouring housing areas. Employees can park along roads, which leads to a ten-minute walk to work.

Shoup (2005) has pointed out the high costs of free parking. Especially that minimum parking requirements stimulates to increase car ownership, increased housing prices and subsidization of car users. The NPRA also subsidises parking. They rent each parking space for 27 000 NOK (3033 Euros) per year. In total they use 3,8 million NOK (426000 Euros) on providing parking for employees. However, parking fees can generate income and reduce the amount of subsidies used on parking. A parking space can maximally generate 6000 NOK yearly if we assume that it is utilised on every weekday (besides holidays and assuming 25 NOK a day for parking).

Method

Two methods were used to answer how a parking fee affect behaviour and acceptance. Travel surveys were used to measure changes in travel behaviour and acceptance at three different periods. Parking utility were also manually counted, which provides data about how many cars were parked during a given week.

The surveys were conducted in three stages. A preliminary survey was done in May 2011. This was three months before the parking fee was introduced. The questionnaire dealt with two main issues: travel habits and attitudes. The first part included mode of transport on the day they answered the survey, how they usually travelled during summer and winter, transportation possibilities and public transport services. The second part studied employee attitudes to parking fees and how they expected the measure would affect their travel habits. A second survey was done in September 2011, which was about a month after the parking fee. A third survey was send in May 2012 – approximately 9 months after the fee was introduced and at the same period as the before study.

The surveys were done by email and each email address was attached to an ID number. This made it possible to analyse any travel behaviour changes for each respondent over time, and we could divide the survey by whether the employees had responded or not responded to the preliminary study. This meant that the first and second follow-up survey were sent in two different versions. Those who answered and completed the preliminary study received a new questionnaire. This was a rather short questionnaire about travel habits, attitudes, and change in travel habits as a result of the parking fee. Those who did not responded or complete the preliminary study, received a new questionnaire which was essentially based on the original preliminary study. The method secures information about the effect of the fee over time.

In total, the surveys were sent to 602 persons. Some were not available at the time of the survey due to sick leave, vacation or business travels. Some were also registered as employees, but worked elsewhere. Others had quitted at the time of the study. This means that the net sample was 589 persons.

The first survey had a response rate on 65 per cent (386 persons). The second survey had a response rate on 64 per cent (380 persons) and the third survey has a response rate on 61 per cent (359 persons). In total, 481 employees responded to one or more of the surveys. The surveys have captured about 81 percent of all employees. However, the response rate drops to 42 percent if we only include respondents that have answered all three surveys.

Gender is the only variable that can be used to assess systematic bias. The NPRA provided the names of all employees. This was used to categorise gender. In total, 43 percent of the employees were women, while 46 per cent were women in the data set. Thus, a slightly higher proportion of women answered the questionnaire, but the difference is small.

The travel survey was supplemented by a manual count of how many cars were parked during a week in May 2011, a week in September and a week in May 2012.

Table 1 – Overview of tasks

	May 2011	June-July 2011	August 2011	September 2011	October-April 2011/2012	May 2012
Introduction of parking fee			√			
Survey	√			√		√
Response rate	65 %			64 %		61 %
Parking coverage	√			√		√

Findings

The effects of a parking fee can be evaluated connected to (i) change in mode used, (ii) change in parking location and (iii) change in the starting time of journeys (Feeney 1989).

Change in mode used

The figure shows the mode of transport to work in spring and autumn 2011 and spring 2012. The main trend is that the car share declines after the parking fee was implemented. 39 per cent used car in spring 2011 compared to 31 per cent in spring 2012. Walking and bicycle are reduced during fall 2011, but are at the same levels as before in the third survey. Public transport increase from 39 percent to 44 percent.

Table 2 – Mode of transport

Mode of transport	May 2011	September 2011	May 2012	Difference
Walking/cycling	19	15	19	0%
Car driver	35	31	27	8% *
Car passenger	4	6	4	0%
Public transport	39	42	44	5%
Home office	2	2	3	1%
Other	1	1	2	1%

* $p < 0.05$

The results are in line with other before and after studies. Shoup (1990:145) refers to three such studies (table 3). The difference in autos driven per 100 employees varies between 18 to 39 percent. All the cases shows a decrease in car use when drivers have to pay for parking. Vaca and Kuzmuak (2005:135) summarise findings from 18 work sites. They find that SOV driving decrease by an average of 21 percentage points in response to parking pricing strategies. For the NPRA, the reduction in car use is 23 percent.

Table 3 – Autos driven per 100 employees

Location, Date	Employer pays for parking	Driver pays for parking	Difference
Downtown Ottawa, 1978	39%	32%	-18%
Mid-Wilshire, Los Angeles, 1984	48%	30%	-38%
Warner Center, Los Angeles, 1989	92%	64%	-30
NPRA, Oslo, 2012	35%	27%	-23 %*

* $p < 0.05$

Employees were also asked to provide an overview of travel habits during winter. It gives a wider perspective on mode of transport by taking into account that mode of travel varies. Travel during the winter season gives a direct comparison with how employees travelled before and after parking fees. Table 4 shows results that are consistent with the effects on mode of transport in table 2. A majority travel by public transport and by car. Relatively few walk or cycle in the winter. The use of public transport increases and car use declines after the parking fee was introduced. There is also an increase in daily travels by public transport, and fewer daily trips by car. The results are validated by comparing the share of employees with a 30-day ticket before and after the parking fee. A higher percentage have season tickets.

The employees at NPRA were asked if they expected to reduce car use as a result of the parking fee. In the follow-up studies, they were asked whether the parking fee had resulted in less car use. The questions were meant to capture whether respondents thought they would and subsequently had changed behaviour due to the fee. The preliminary study showed that 10 percent expected to use car less. In spring 2012, 12 percent stated they had reduced less car due to the parking fee.

Table 4 – Use of public transport tickets and travels during winter

	Before	After
30-day travel ticket/yearly ticket	38 %	47 % *
Daily travels by PT during winter	36 %	41 %
Daily car driver during winter	26 %	23 %
Less car use	10 %	12 %

*p<0.05

The study also involved manual counts of parked cars for a total of 14 days during spring 2011, autumn 2011 and spring 2012. We therefore have a wider empirical basis for studying the effect of parking fees.

The results shows a significant decrease in the number of cars parked. On average, about 97 percent of the parking spaces were used prior to the parking fee (St. Deviation=4,1). Thus, the capacity was nearly fully utilised. The average dropped to 76 percent one month after the fee (St. Deviation=5,8). In May 2012, the average was 81 percent (St. Deviation=8,1). In the autumn 2011, it was an average reduction of 26 vehicles per day and about 130 cars per week. In the spring of 2012, there were about 100 fewer cars weekly. The manual count thus shows the same tendency as the surveys. There were fewer people driving to work after the parking fee was introduced. Consequently, it is easier to find a free parking space for those driving to work.

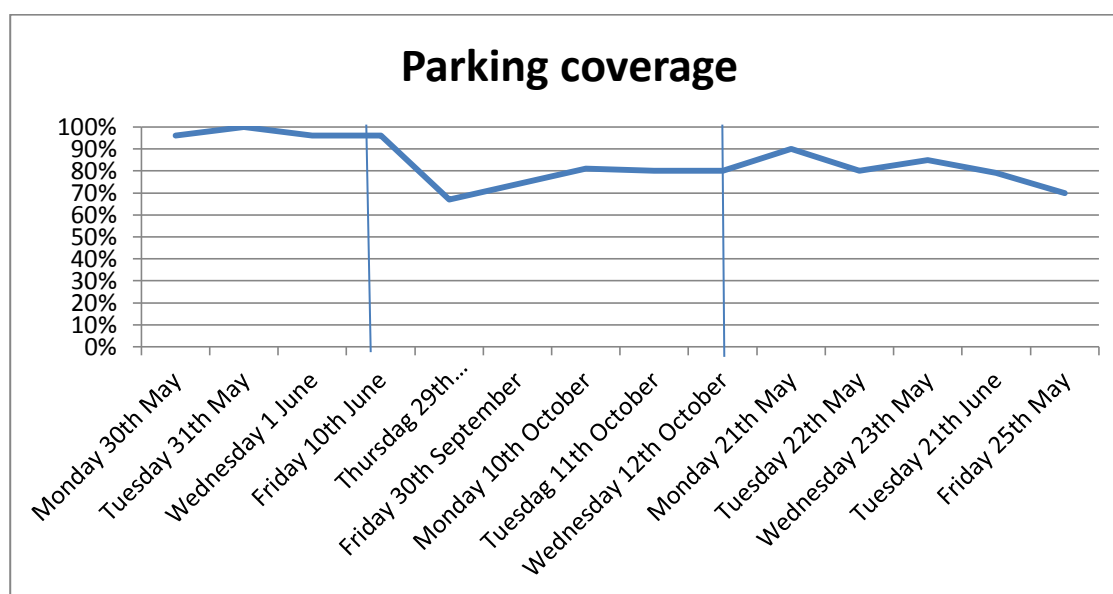


Figure 1 – Parking coverage

Change in parking location

Ferguson (1999) conducted a case study in Atlanta. He argues that commuters are more likely to find alternative parking than changing mode of transport if parking at work are priced. This is especially the case if the majority drives to work and there are alternative parking facilities nearby. Employees at the Norwegian Public Road Administration have limited possibilities for finding alternative parking. The NPRA has a reserved parking lot for visitors (which is not controlled). However, employees can park along roads, which leads to a ten minute walk to work.

The results indicate a spillover effect due to parking fees. Two percent parked on streets or parking lots without fee in spring 2011. The share rose to eight percent one month after NPRA implemented a parking fee. Six percent said they found alternative free parking in spring 2012. The effects of spillover is thus weak, which can be explained by limited possibilities for finding alternative parking.

Table 5 – Parking location for car drivers

Parking	May 2011	September 2011	May 2012
Street, parking lot without fee	2	8	6
Street, parking lot with fee	2	3	2
Visitors parking	2	2	0
Parking reserved for employees	94	87	92

p < 0.05, chi-square test

Change in the starting time of journeys

Free parking means that there will be a high demand for parking lots. Above, it has been shown that the parking capacity was full before the parking charge was implemented. This can influence starting time for work travels. In order to capture this aspect, car drivers were asked if they needed to travel early to find a free parking space. Table 6 illustrates that the proportion who states that they are traveling early to secure a parking space has been reduced from 69 to 31 percent. Thus, the parking fee has contributed to making it easier for those driving to find parking space and has therefore influenced starting time of journeys

Table 6 – Change in starting time of journeys

Parking	May 2011	May 2012
Need to travel early to secure parking space	69	31
Parking coverage does not influence departure time	31	68

p < 0.05, chi-square test

Findings on how acceptance evolves over time

The effect of an instrument can be measured in several ways. We have above studied how the parking fee has influenced the mode of transport to work, change in parking location and change in starting time for journeys. Another key element is legitimacy and study whether the parking fee has support among the employees and how support may change over time. In this case, the acceptance is measured by whether employees are positive or negative towards the measure.

The acceptance before the parking fee was introduced can be roughly categorized as follows. One third were against the parking fee, one third were neutral and one third were positive. However, the share of employees being positive increases after the parking fee was introduced, and the share of employees being negative is reduced. One year after the parking fee over 45 percent were positive towards the measure, one of three were neutral and 22 percent negative. Thus, the acceptance increased after they experienced the impact of parking fees. The development can be compared with the introduction of congestion charges in Stockholm. Support for congestion charging was higher after the measure was implemented (Schuitema, Step and Forward 2010).

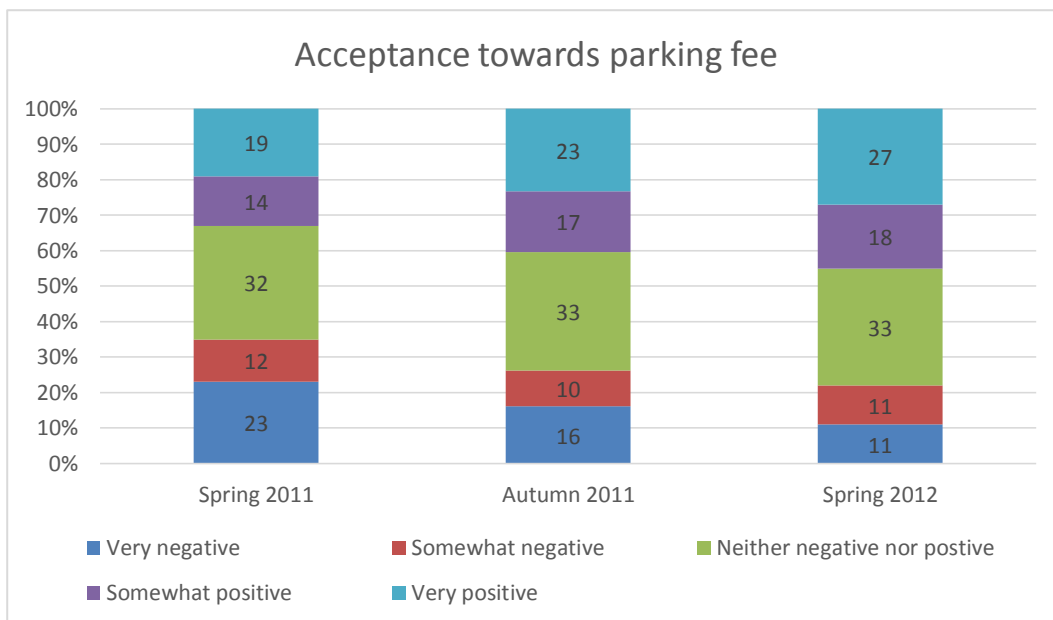


Figure 2 – Acceptance towards parking fee

$p < 0.01$, chi-square test

The employees were asked to state why they were negative towards the parking fee in the second and third survey. Most responded that the alternatives to the car are not good enough (31 percent). 27 percent of the responses stated that employers should offer free parking to employees. Higher costs are also a major reason why employees are negative.

The employees were also asked why they were positive. The response categories were divided into five categories. The first category covers ideology connected to that the employer should not subsidize parking. NPRA spent over 3.8 million NOK per year to subsidize parking before the fee. Approximately one fifth responded that this is a reason why they were positive. The environmental aspect is related to the parking fee contributes to less car use. Parking fee is from the employer's side intended to reduce unnecessary driving and follow national guidelines to encourage reduced car use. This option provides the greatest support, and shows that environmental impact has the greatest explanatory power.

Another environmental argument is that parking fee promotes NPRA as an environmentally conscious employer. They function as a good example for other businesses after introducing a fee. This option has the second most votes. Nearly one in four states that this as one reason for being positive. A more pragmatic argument is that the fee makes it easier to find parking. We have previously demonstrated that there is a clear tendency that drivers do not have to arrive early in order to secure parking space. This can partially explain why employees have been more positive.

Overall, the findings give support to the thesis that acceptability increases when the public has familiarity with a (restrictive) measure and experience the effects (Jones 2003, Eliasson and Jonsson 2011).

Table 7 – Causes for being negative or positive towards the parking fee

Why negative to parking fee	Percent
The alternatives for not driving is not good enough	31
Employer should offer free parking to employees	27
Transport expenses will increase	23
Other	19
Why positive to parking fee	Percent
The parking fee profiles the NPRA as an environmental employer	24
The parking fee makes it easier to find a parking space	19
The parking fee contributes to less car use	32
The employer should not subsidise parking	21
Other	4

Acceptance and mode of transport

According to Jaensirisak et al. (2005) there has been relative few studies about how acceptability differs for road pricing between users and non-users. In their study, they found, by the use of stated preferences that road pricing was more acceptable to non-users, people with environmental concerns and those who thought the scheme would be effective. Table 8 shows how acceptance varies according to car use for employees at the NPRA before and after the fee (in brackets) was implemented. Those who drove daily to work in the winter were largely negative to the fee, while those who did not often travel by car were more positive. The share of employees being positive are larger for all categories after the introduction of the fee. However, the acceptance are far greater for workers that seldom use car on their work travels. Thus, the results give support to the hypothesis that the car drivers are most negative towards the fee.

Table 8 – Car use during winter and attitudes to the parking fee

	Very positive	Rather positive	Neither positive or negative	Rather negative	Very negative	
Car use at least 5 times a week	4(14)	9(14)	27(33)	18(16)	42(23)	100 (N=100&81)
Car use 1-4 times a week	12(17)	18(25)	26(30)	16(14)	28 (14)	100 (N=76&71)
Less than 1 time a week	30(35)	15(17)	37(33)	7(7)	11(6)	100 (N=210&206)

p< 0.01, chi-square test

Acceptance and earmarking of revenues

Kallbekken and Sælen (2011) have studied how earmarking can help to increase support for higher fuel taxes in Norway. The results showed that earmarking helps to increase acceptance. One main reason is that people do not think a higher tax will help to improve the environment if the money is not earmarked for environmental purposes (ibid). The employees that were neutral or negative towards the parking fee were asked whether they would be positive if the revenues from the parking were earmarked to measures that facilitates for environmental friendly transport.

The results suggest that this is the case. During spring 2012, one in three (previously neutral or negative) would be very or rather positive, 46 percent stated that they would remain neutral, while 33 percent would still be negative. Overall, these findings suggests that support for the parking fee would increase significantly if the revenues were earmarked.

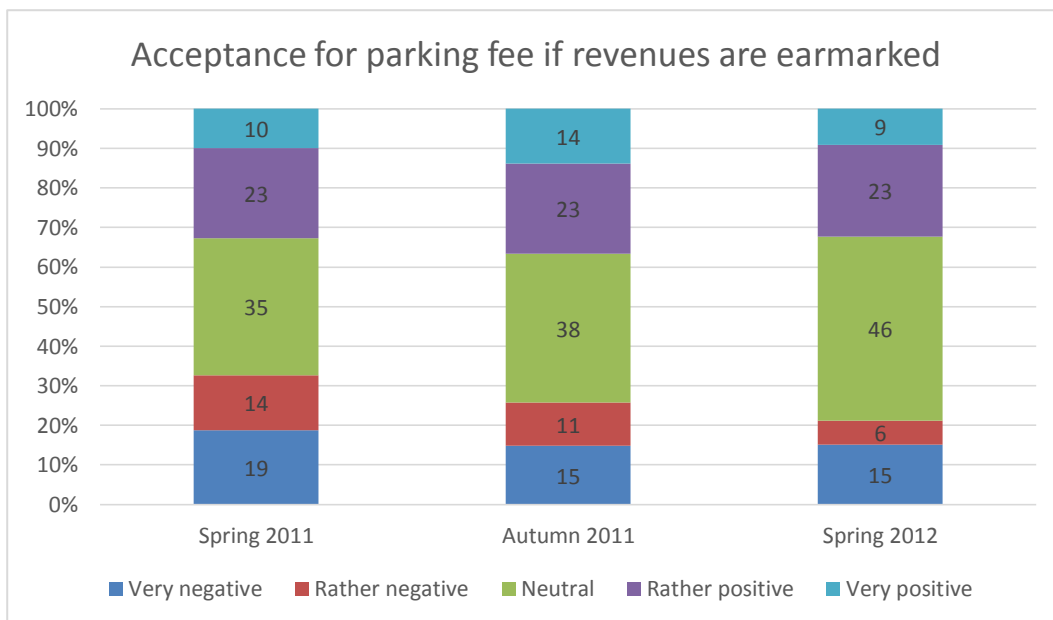


Figure 3 – Car use during winter and attitudes to the parking fee
 $p < 0.01$, chi-square test

Discussion and conclusion

Parking restrictions have for long been recognized as important for influencing travel behaviour and can thus play an important role in strategies for reducing congestion and pollution. The majority of workers in Oslo have free parking and this article documents that a modest parking fee has nudged employees to use less car. The occupancy at the parking garage has been reduced from 97 to 81 percent and the car share has been reduced by 23 percent. 12 percent of the workers state that they use less car after the parking fee was introduced. The parking fee has consequently affected the parking demand and parking utilisation. This means that a parking fee can be a well-functioning instrument also in areas outside the most central areas in a city. It also shows that the fee can be rather small in order to induce changes, even though the effects would be larger with higher costs. Moreover, the parking fee symbolises that NPRA takes its environmental responsibilities seriously. The symbolic factor is also one factor that explains why employees are positive towards the fee.

However, the findings also highlights the importance of contextual factors. There are tendencies towards spillover parking, but the effect is weak. This can probably be attributed to the fact that parking along roads in nearby areas would result in 5-10 minutes walking and that the fee is rather modest. At any rate, taking into account local transport factors are required in order to reduce the negative effects. In order to reduce spillover parking, local authorities can introduce residential zone parking (Mingardo et al. 2015).

For the employees, the effects are not only negative. The fee costs 6000 NOK per year if we assume that an employee drives to work every day. This is a modes cost compared to the market price (27 000 NOK). However, before the parking fee it was necessary to arrive early in order to secure a parking space. After the fee, the majority stated that they did not need to arrive early. The fee has consequently made the journeys more flexible since car drivers were secured a parking space no matter at what time of day they arrived. This effect has also increased the acceptability. Employers could thus use such an argument before a fee is introduced in order to increase the understanding and acceptability. This indicated the importance of how the fee is framed.

The case study also shows that parking fees can be controversial. Before the fee, 35 percent were negative and those who drove to work frequently were most inclined to be negative. The main reasons for being negative were not good enough alternatives to the car and increased costs. This illustrates the importance of highlighting the costs of providing free parking. Acceptance and understanding of the project may

increase by showing that car drivers, in this case, was subsidized with a sum that could give all employees free annual ticket for public transport.

The case study also documented that the employer could increase acceptance by use the income from the fee to promote environmental friendly transport. By earmarking funds or implement measures that stimulate to less car use, the employer uses both carrot and stick in order to encourage to environmentally friendly transport.

In the end the workers became positive towards the fee. This indicates that parking fees could be introduced despite resistance since acceptability increase when the benefits are demonstrated. Especially if the parking spaces are already fully utilized.

Further researcher may be extended to include studying how price elasticity for parking fees at work travels varies for different geographical contexts. Moreover, further studies are needed on strategies to increase acceptance for restrictive measures at work places.

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