

A PARKING MANAGEMENT SCHEME FOR PRIVATE CAR PARKS – A PROMISING APPROACH TO MITIGATE CONGESTION ON URBAN ROADS?

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ABSTRACT

One of the most effective traffic demand management measures is parking management (paid parking zones, limitation of parking duration, residents' parking privilege, environment- oriented parking fees etc.). A big problem arises due to the limitation of these regulations to public space. In many western cities the share of private parking slots, especially those of shopping centres and commuter car parks, exceeds those on public roads. This fact makes parking management schemes less effective and calls for new instruments to limit the car traffic to a level that helps to avoid congestion. Mainly two options are being considered: Any type of congestion pricing or extension of parking management strategies to private car parks. To investigate the latter, a study was conducted to identify possible alternative solutions and to evaluate the impacts and effects on traffic demand, because there are only few examples for this type of measures in real life.

The following main options were analysed in the “Case Study for the Vienna Region”:

- Obligatory pay parking schemes for shopping centres and other privately owned large car parks; this could be managed by a parking fee for customers or a parking slot fee per offered space levied by the operator. The revenues could be handed to a regional authority (e.g. in form of an environmental protection or council accessibility tax).
- Obligatory limitation of car trips to shopping centres by a defined trip quota, depending on air pollution;
- Obligatory limitation of the maximum number of parking slots, depending on the accessibility by public transport and/or on air pollution.

The behavioural changes of car users and effects on operators and developers as well as the general acceptance and attitudes were investigated by stated preference analysis and interactive in-depth interviews with different target populations.

The stated preference analysis indicates that a very effective change of travel behaviour is possible, with a relatively strong user-price-elasticity for car drivers. That means that a shift from car to other modes can be observed, depending on the quality of accessibility of the alternative modes and of the travel purpose. But it is evident that parking management for private car parks is only effective if the public road space in the vicinity is included in the parking management scheme. In the long run, undesirable migration-of-enterprises-effects can be expected and might lead to urban sprawl, if the area of the parking management scheme is too small. One can draw the conclusion that parking management for private car parks is a promising and successful instrument to mitigate traffic congestion if specific framework conditions are taken into account.

1. PROBLEM DEFINITION

One of the most effective traffic demand management measures is parking management (paid parking zones, limitation of parking duration, residents' parking privilege, environment- oriented parking fees etc.). A big problem arises due to the limitation of these regulations to public space. In many western cities the share of private parking slots, especially those of shopping centres and commuter car parks, exceeds those on public roads. This fact makes parking management schemes less effective and calls for new instruments to limit the car traffic to a level that helps to avoid congestion. Mainly two options are being considered: Any type of congestion pricing or extension of parking management strategies to private car parks. To investigate the latter, a study was conducted to identify possible alternative solutions and to evaluate the impacts and effects on traffic demand, because there are only few examples for this type of measures in real life.

The Case Study for the Vienna Region had the objectives to analyse both the reaction of car users to various types of parking management for parking slots in private car parks and the long term effects upon the operators of such private car parks. The survey focused mainly on car parks available for customers of shopping centres and leisure facilities but also parking slots for commuters of large companies with 50+ slots. As far as the reactions of car users upon the parking management of parking slots on private ground are concerned, the following are of particular interest: change of modes of transport, switch to different targets in alternative areas without parking management, moving away from paid parking zones to free of charge public road spaces in the vicinity, and abstaining from the trip. As far as the reaction of the operators is concerned, the long term effect of an obligatory management of private parking slots upon the choice of site is of particular interest. For example, a relocation of facilities to the surrounding area of cities without parking management in private car parks would be counterproductive. This would mean that in the long run, companies move out of cities, it would lead to increasingly car-oriented spatial structures, a growing use of cars, and at least intensified traffic congestion.

2. INTERNATIONAL EXPERIENCE

An analysis of international examples of rules and regulations regarding parking slots and parking management showed three different types of measures. This research was conducted in 27 cities in 13 different countries (Klementsitz, Sammer, Stark et al 2005):

- An obligatory limitation of maximum number of parking slots: A total of 44% of the cities have rules regarding the limitation of the number of parking slots per usable area of a building. Such limitations vary from one parking slot per 60 m² to 200 m² gross floor space, depending on location and type of use. In general, such limitations only exist for car parks used by office buildings and shopping centres. Reasons given for such upper limits are the good availability of public transport or the desire to prevent air pollution. These types of measures are already standard procedure in many countries.
- A local traffic generation tax per parking slot: Charges which municipal authorities levy on operators of private parking slots as a kind of environment or development fee are tested in few pilot projects in Switzerland (Arbeitsgemeinschaft Metron/Neosys/HSR 2002). In Switzerland, the main reason for local taxes upon traffic generation (also called local accessibility tax) is the desire to compensate

for the negative impact of car traffic on the air quality in conurbations. Since 1999 the legal possibility exists in Austria to levy local traffic generation taxes on shopping centres (ÖPNV-G 1999). But so far, this law has not been applied because communities are worried about the potential negative impact upon the future choice of location of enterprises.

- Mobility management and parking management: In 70% of the cities included in the survey examples for mobility management measures by companies in connection with parking management exist for companies with large car parks. In general companies introduce them on a voluntary basis; they tend to offer incentives for commuters not to use their cars, for example the so called „Job-Jahresticket“ [That is a job-related annual season ticket with discount rate funded by the employer.], bonuses, and get-home-guarantees for carpools, etc. A new idea which is currently being tested in Switzerland is the car trip quota system for customers of shopping centres (Saentispark 2004, Kanton St. Gallen 2004).

3. OPTIONS FOR PARKING MANAGEMENT SCHEMES FOR PRIVATE CAR PARKS

The case study considers the Vienna conurbation with its surrounding area. Four different scenarios for the parking management of private parking slots were investigated.

3.1. Introduction of an obligatory limitation of the maximum number of private parking slots for customers and commuters

The obligatory limitation of the maximum number of parking slots relates to the parking slots per usable area of the building und depends on the following characteristics of the site:

- Location of the site: city centre, outskirts, or industrial area;
- Type of operation: office and administration building, business enterprise, leisure facility, some kind of shopping centre.

The introduction of a limited number of parking slots means that there is a lack of free slots for customers, that they have to find free slots in the vicinity, or that they have to wait until a parking slot becomes available. Commuters react by looking for alternative parking slots or by switching from their cars to alternative modes of transport.

3.2. Introduction of an obligatory pay parking scheme for operators of large private car parks

This charge might be anything from 60 to 100 €/month and parking slot, depending on the location and the type of operation (see point 3.1) and should be paid over to the organisation maintaining the road, earmarked for environmental protection. This kind of parking management indirectly controls the travel demand of car users, depending on the fraction of the charge which the car driver has to bear. This kind of charge primarily affects the operator by minimizing the offer of parking slots either to avoid excess capacities or to influence the choice of location in the long run.

3.3. Introduction of obligatory parking fees for customers and commuters

The size of the fee depends on the same characteristics of the location as mentioned above under point 3.1. The fee for short-term parking of customers usually ranges

from 0.80 to 1.80 € per hour, the obligatory parking fee for commuters as all-day parkers ranges from 60 to 100 € per month, depending on the location. These user-related fees have a direct impact upon the travel demand of customers and commuters.

3.4. Trip quotas in combination with mobility management for customers

For each operator this measure limits the number of allowed accesses of cars per year, for example to avoid air pollution. Depending on the location, the type of shopping centre, or industrial area, a quota of 20 to 200 car accesses per 1000 m² usable area and day is permitted. Within a year, this quota should not be exceeded: Should this happen, a penalty of 0,20 €/access for every access above the quota has to be paid by the operator. The level of the penalty is derived from the external costs of an average car trip. The operator is advised to use mobility management measures to prevent his customers from violating the quota. This measure has no direct impact upon the car user; it only affects demand if the operator takes suitable steps to avoid that his access quota is exceeded.

4. METHODOLOGY

The survey had the objective to determine the impact of the different types of parking management defined in section 3 on the demand for car access and the operators of shopping centres and other business enterprises. To achieve this it was necessary to use interview techniques which made it possible to determine the behaviour of car users and operators. For this case study the so called „stated preference technique“ (Sammer 2003) was used as part of an interactive in-depth-survey, both for car users and for operators.

4.1. Survey of car users

Telephone interviews were conducted with car users. Initially, respondents were asked whether they had used the car during the last few days to reach a shopping, leisure, or work destination. In order to get a realistic idea of the behavioural change, respondents should recall real life destinations. Those people who mentioned that they had been on such trips were asked in detail about their travel behaviour to these destinations. Then the car drivers were asked about the various potential measures, i.e. how would they behave if a specific measure were introduced at their destination. A total of 229 trips were discussed with the „stated-preference technique“, 55 % for shopping, 26 % for leisure and 19 % for commuting purposes (Table 1).

Table 1: Sample for the travel behaviour survey

gross sample	709 respondents
net sample (people who had been on relevant trips and were prepared to participate in the interview)	144 respondents
	229 trips

4.2. Survey of operators of shopping centres and industrial enterprises

To ascertain the reaction of operators to the various options, an interactive in-depth-interview was conducted with each of them in their office. A semi-structured questionnaire was used to have a standardized framework but at the same time to

capture all possible reactions and their reasons with open-ended questions. A total of 25 operators were interviewed, all of them active in the Vienna region considered in this survey (Table 2).

Table 2: Sample of operators of various enterprises

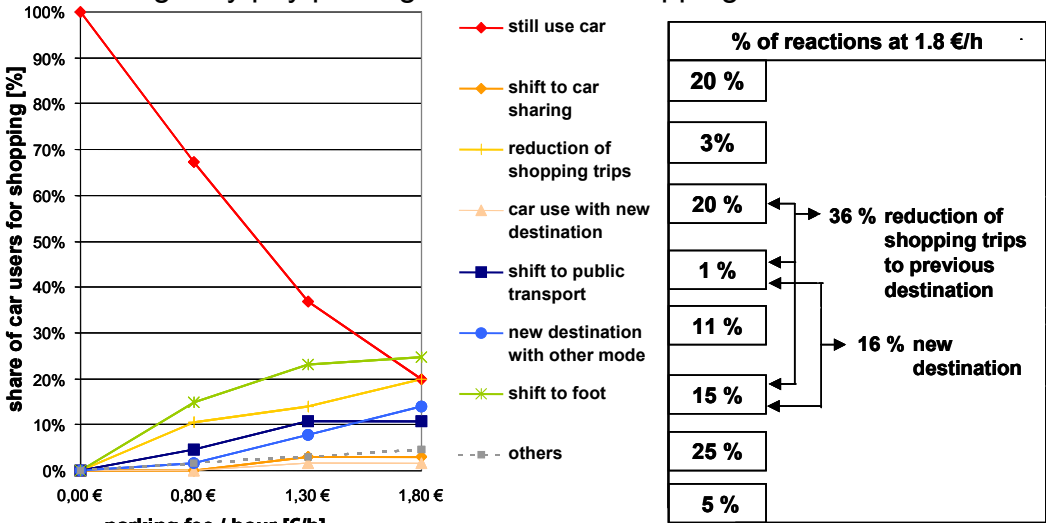
Type of enterprise	net sample
shopping centres	11 respondents
leisure facilities	6 respondents
business enterprises	4 respondents
office buildings	4 respondents
Total	25 respondents

5. THE EFFECT OF PARKING MANAGEMENT OF PRIVATE PARKING SLOTS UPON THE USE OF CARS

5.1. Obligatory parking fees for parking slots of shopping centres

In the analysis the reaction to parking fees from 0.80 €/h to 1.80 €/h for shopping centres was ascertained. A fairly wide variety of options are possible (figure. 1).

Fig. 1: Behavioural reaction of users of cars for shopping purposes to obligatory pay parking schemes for shopping centres in Vienna



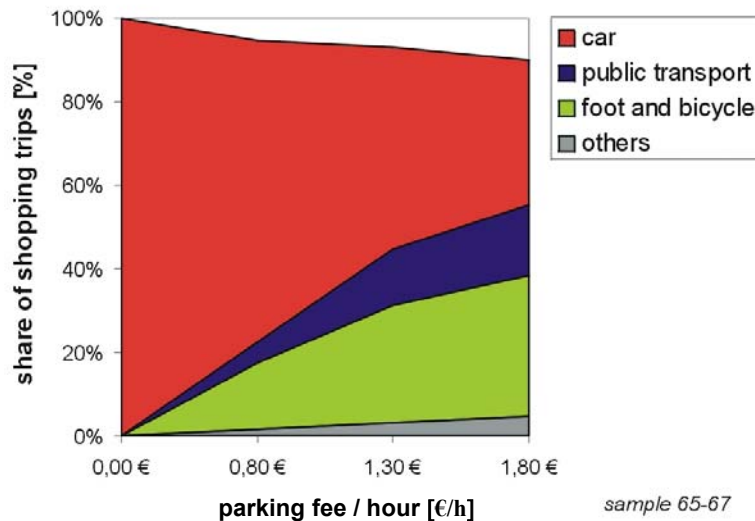
Sample 65-67

Car user react in a very sensitive way to parking fees: The higher the parking fee in well developed urban areas the more likely car users will switch to alternatives, such as public transport or walking. At a parking fee of € 1.80/h 16% of respondents pick an other shopping destination where no fees are levied and 36% do no longer frequent the original shopping destination if they have to pay parking fees there. This means a risk for the competitive situation of shopping centres which levy parking fees compared to those which don't. Figure 1 does not show that 19% of car users spontaneously mentioned that the introduction of parking fees for a private customer car park would make them use parking slots on public roads, because such slots are easily available in the vicinity of the chosen destination. In such cases respondents were given the additional information that the same parking fee would be levied for public parking slots, too. The results shown in figure 1 reflect these latter conditions.

Figure 2 shows the effect of the reaction of car drivers upon the modal split.

It is very obvious that the elasticity of car trips is high: With rising parking fees the number of car trips decreases rapidly to be replaced by walking or cycling. This means that the introduction of parking fees could significantly contribute to the reduction of congestions, provided private parking slots account for a high share of all parking slots.

Fig. 2: Change of modal split for shopping purposes as a result of obligatory pay parking schemes for shopping centres in Vienna



The effect of parking management close to shopping centres at the outskirts of cities in conurbations upon the demand for car traffic is significantly lower, as figures 3 and 4 demonstrate. But the number of car trips for collective purchases instead of several trips for smaller purchases increases.

Fig. 3: Behavioural reaction of users of cars for shopping purposes to an obligatory pay parking scheme for shopping centres at the outskirts of Vienna

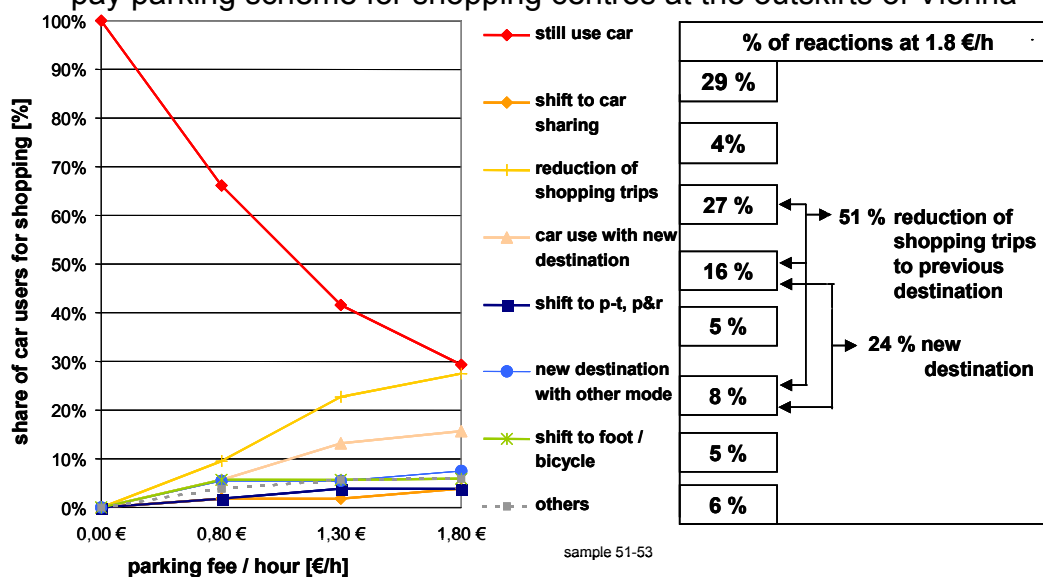
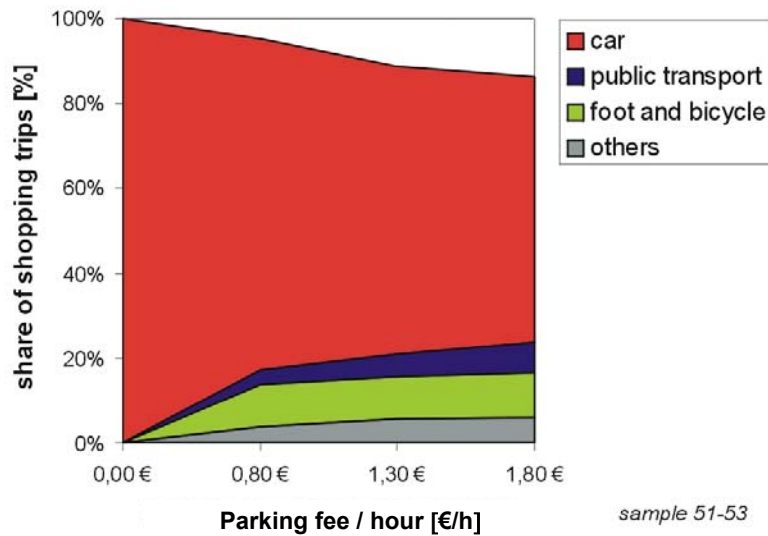


Fig. 4: Change of modal split for shopping purposes as a result of an obligatory pay parking schemes for shopping centres at the outskirts of Vienna

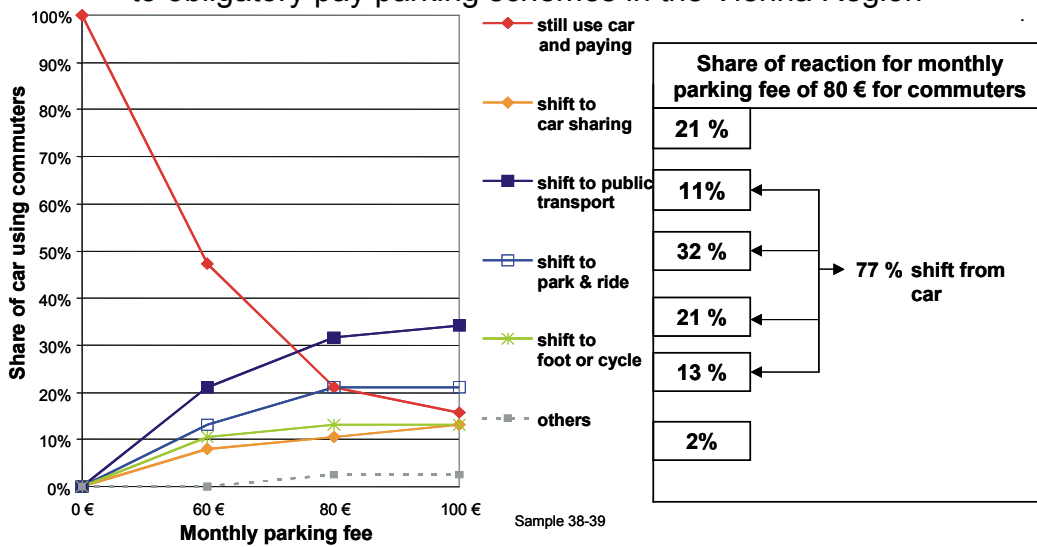


About 50 percent of the operators of shopping centres react in a negative way to the obligatory introduction of parking fees for parking slots. They argue that this would be damaging to the image of the shopping centre and they hold the opinion that it would be difficult to explain such measures to customers. All operators would refund the parking fees to their customers in such a case. This means that the control effect upon the demand for car trips would be lost. It might be possible to compensate for such refunding by combining parking management with the levy of an obligatory parking slot charge on operators.

5.2. Obligatory parking fees on company car parks for commuters

In the survey commuters, who currently use their car to drive to work, were asked about their reaction to obligatory parking fees from 60 to 100 €/month. As it turned out, reactions vary considerably and are highly elastic regarding to car travel demand. In the case of a fee of 100 €/month, 22 % of respondents would try to find a parking slot on the roads and streets in the vicinity of their work place. Should this not be possible they would react as shown in figure 5. When it comes to commuting, car drivers react far more elastic regarding the switch to other modes of transport than in regard to their purchasing traffic, because in the short run they are unable to find another work place. The majority of commuters would either completely switch to public transport or to Park & Ride, few would opt for car sharing or non-motorized transport.

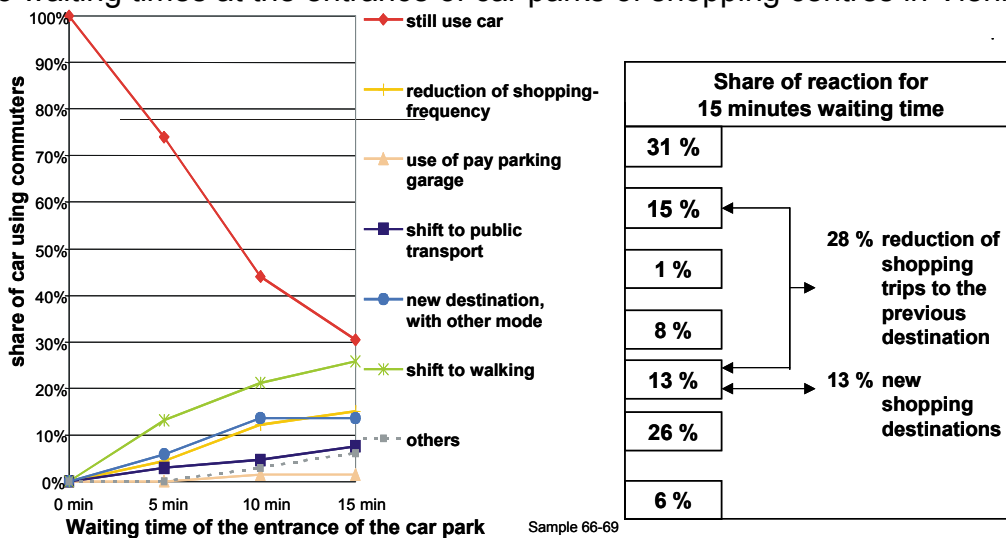
Fig. 5: Behavioural reaction of car using commuters to obligatory pay parking schemes in the Vienna Region



5.3. Obligatory limitation of the maximum number of parking slots and quotas for car access to shopping centres

Both measures have the effect that there is a shortage of parking slots for customers. If a customer drives to a shopping centre where parking slots are scarce he has to accept some waiting time if all slots are taken. If the waiting time increases, the behaviour of the driver is likely to change. If they had to wait for five minutes, 10 % of respondents would try to find a parking slot on the roads in the vicinity. Figure 6 shows the likely behaviour if no free parking slots are available in the vicinity. The effect is an indirect one and is due to the experience car user made on previous shopping trips. Since such experience is influenced by the utilization of the car park on previous occasions at very different times, the results vary considerably. This results in a big variance of the behavioural reactions.

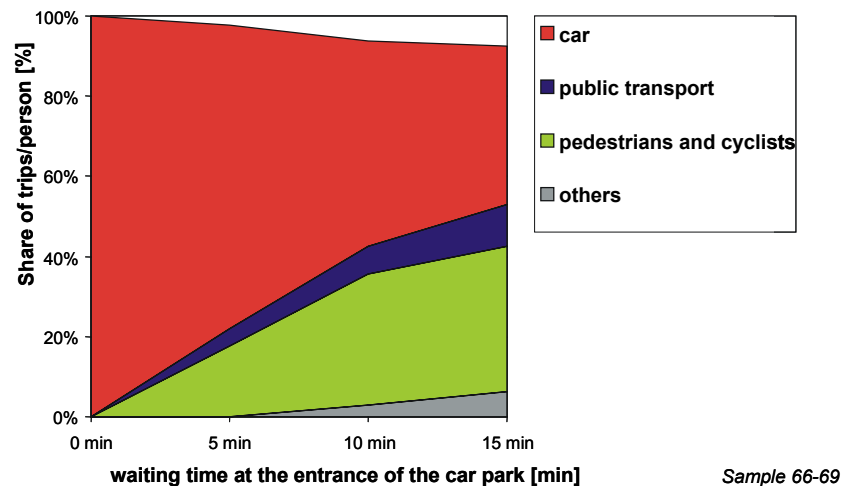
Fig. 6: Behavioural reaction of users of cars for shopping purposes to waiting times at the entrance of car parks of shopping centres in Vienna



Given this scenario, the effects upon the use of cars vary considerably. The majority of car users reduce the frequency of their shopping trips and opt for few bulk purchases. A comparatively large share of current car users would start to walk under

these conditions. The competitiveness of the shopping centre is at risk because a fair share of car users would opt for different shopping destinations without overcrowded car parks. Figure 7 shows the effect of waiting times at the entrance of car parks upon the modal split.

Fig. 7: Change of the modal split for shopping purposes as a result of the waiting time at the entrance of car parks of shopping centres in Vienna



Operators of shopping centres react in a very negative way upon the obligatory introduction of a limitation of the maximum number of parking slots. They particularly reject this measure for locations at the outskirts of conurbations and claim that it would have a major impact upon the decision where to choose locations for future shopping centres. This measure would mean a shift to zones without a limitation of the maximum number of parking slots. The idea of introducing a quota for car access by customers seems incomprehensible, the whole scheme difficult to manage. Should such a measure be introduced in one zone, shopping centres are likely to move to zones without such quotas for car access.

6. CONCLUSIONS

The results of the stated preference analysis lead to the following conclusions regarding the effects of parking management of private parking slots; it is necessary to differentiate between short-term and long-term effects. The objective of any such measures is the control of car travel demand to avoid congestions and negative impacts upon the environment. The results indicate the likelihood of some probably undesirable side-effects which might be compensated for in part by concomitant measures. It is necessary to bear in mind that the behavioural elasticities which could be observed indicate the maximum potential of behavioural changes. For reasons of methodology the stated preference analysis used is based on the assumption that respondents are fully informed about and aware of alternative options and the issues involved. It can be proved that in reality people are generally not that well informed and aware of their options (Sammer 2006).

6.1. Obligatory parking fees for customers and commuters

This measure has a high control effect upon car travel demand and is highly suitable if the private parking slots account for a certain amount, at least one third, of all

parking slots. For the measure to be effective it is necessary that parking facilities on public roads in the vicinity of such private paid parking zones are also subject to the same parking management as far as the level of the parking fee is concerned. The control effect is considerably lower if the operators of shopping centres refund the parking fees to their customers. This can be offset by an obligatory charge for traffic generation per parking slot which the municipal authorities levy on operators (a so-called traffic generation charge).

One has to bear in mind that a considerable number of car users opt for other shopping destinations if comparable shopping centres which do not charge parking fees are within convenient reach. This can mean that shopping centres and enterprises with considerable customer traffic which do charge parking fees are at a disadvantage. To uphold free competition it is necessary to have the same basic rules and regulations for all private car parks in a spatially and functionally coherent area, but a graduation of parking fees depending on the quality of the development of the site and the ease of access by alternatives modes of transport (public and non-motorized) is recommended. One can also argue in favour of such a graduation on the basis of the different behavioural elasticities of car users depending on the location of the site in relation to the city centre.

In the long run, operators of shopping centres and leisure facilities consider moving such centres, facilities, and enterprises to other areas unless the same parking rules apply to all public and private parking facilities within a spatially and functionally coherent customer catchment area. Such a migration would mean that in the long run such facilities and enterprises choose sites at the outskirts of cities which would lead to an undesirable urban sprawl and the counterproductive effect of longer car trips. To avoid such unwanted side-effects obligatory parking fees for private car parks have to be introduced in large spatially and functionally coherent catchment areas. From an administrative point of view it seems recommendable to apply this rule only to private car parks of a minimum size, for example 50+ parking slots.

6.2. Limitation of the maximum number of parking slots and trip quotas for private car parks

The introduction of a limitation of the maximum number of parking slots and of trip quotas for private car parks of shopping centres and other facilities does not lead to any immediate control of the travel demand of car users. But the financial pressure upon the operator might have indirect effects because he might reduce the number of available parking slots because of the cost. At peak times, such shortage has an impact upon travel demand because potential users of car parks have to accept waiting times. But this is not a direct impact and therefore difficult to supervise to achieve the desired effect upon the demand. Car users react depending on past experience and such experience might differ depending on the season, the day of the week, and the time of day. The signal to the car users which is meant to control their traffic demand is not as plain and clear as an easy to communicate parking fee of a certain amount.

Besides the few direct ones the effects upon car users are similar to those already mentioned above: They would try to park on roads in the vicinity and/or switch to destinations where parking slots are not scarce, unless the same rules apply to all shopping centres and leisure facilities.

In the long run operators are likely to move to other locations, but this can be prevented by introducing the scheme in all spatially and functionally coherent areas within the whole conurbation. There is the administrative and legal problem that such a rule can only be applied to new locations for shopping centres and leisure facilities but not to already existing centres and facilities. This would lead to a distortion of competition with all its undesirable side-effects. To avoid air pollution it is easy to argue in favour of all kinds of trip quotas. It can be generally observed that the option of introducing a limitation of the maximum number of parking slots and trip quotas is less effective than parking fees, but such measures are suitable as useful addition to obligatory parking fees.

6.3. Parking charges for operators of private car parks

The introduction of a charge per parking slot (traffic generation charge) for operators of shopping centres, leisure facilities, and enterprises has no direct effect upon the travel demand of car users. Such a measure leads operators of private car parks to choose and plan carefully and to opt for a fairly low number of parking slots within their option. One can only expect such shortages to have indirect and few controlling effects upon the travel demand.

As far as the operators are concerned the effects are the same ones as for the other options. Therefore the introduction of this measure only makes sense in a large spatially and functionally coherent catchment area of a conurbation. Only thus distortions of competition and consequently migrations to other locations can be avoided. This measure is particularly useful in combination with an obligatory parking fee, because it helps to prevent operators from refunding parking fees, a step which would prevent the parking fee from having a controlling effect upon traffic demand.

7. SUMMARY AND RECOMMENDATIONS

The control of the travel demand of car users and thus congestions with the help of parking management on public roads and streets has less and less effect due to the growing number of private car parks for shopping centres, leisure facilities, and enterprises. In some cities private car parks account for more than 50% of all parking facilities. Therefore the use of suitable measures to include these car parks in the parking management is a promising solution. Of the measures investigated the obligatory introduction of parking fees for customers and commuters who use private car parks seems to have a good controlling effect upon the travel demand and mitigates traffic congestion. By taking suitable additional measures undesirable side-effects such as increased parking on public roads or a switch to other shopping centres at the outskirts of cities can be avoided. Such measures might be the extensive management of public parking slots in the vicinity of such private car parks and the obligatory introduction of the rules guiding parking fees within the whole conurbation including the outskirts of cities to avoid a distortion of competition and urban sprawl. One can draw the conclusion that parking management for private car parks is a promising and successful instrument to mitigate traffic congestion if specific framework conditions are taken into account.

On its own, the option of obligatory municipal charges per parking slot for operators and the introduction of tough limitations of the maximum number of parking slots for shopping centres, leisure facilities, and enterprises has only a small controlling effect

upon the travel demand and can therefore only be recommended in combination with obligatory parking fees for private car parks.

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