Transport Policy 46 (2016) 40–45

Contents lists available at ScienceDirect

Transport Policy

journal homepage: www.elsevier.com/locate/tranpol

User response to parking policy change: A comparison of stated and revealed preference data

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ARTICLE INFO

Article history:
Received 22 December 2014
Received in revised form
30 October 2015
Accepted 13 November 2015
Available online 22 November 2015

Keywords:
Parking price
Elasticity
Stated preference
Revealed preference

ABSTRACT

In the available literature it is difficult to determine the impact of the real parking price change on parking demand–probably because the application of such measures requires more recent data. In any case, in the future, once this measure is defined, quantification of the effects should be expected, which will be of great significance for further outlooks on this policy. This paper studies and quantifies the impact of an increase in parking price on the demand and operation of parking garages in central Belgrade. In addition, the paper investigates to what extent the planned demand, estimated on the basis of users' attitudes toward parking price, is in agreement with the actual demand after the price change. Confirmed agreement between the forecasted and actual demand contributes to a greater reliability in achieving the expected effects on the basis of the price determined through predicted demand.

1. Introduction

Parking, as a part of the transport system of a city, acquires greater importance when defining transport policy. Parking management is frequently perceived as being crucial in addressing traffic congestion through its impact on the time spent searching for parking (Shoup, 2006).

Charging for parking is considered to be a powerful transport demand management policy. In the context of parking policy, charging for parking (along with the spatial and temporal structure of pricing) is identified as a very important factor in influencing car use and travel behaviour (Higgins, 1992; Hensher and King, 2001). Consequently, the price elasticity of parking demand is of great importance in parking policy. Knowledge of parking price elasticity makes it possible to define a parking price for different periods throughout the day, guaranteeing targeted parking occupancy. Achieving the targeted occupancy produces a series of positive impacts on parking and also on the operation of the entire transport system of a city, such as the changes in location/type of car park, transport mode, journey time, trip destination, or abandonment of the trip entirely (Feeney, 1989). Accordingly, through pricing it is possible to manage the amount of parking demand, as well as its time and spatial distribution (including distribution according to type of car parks). In addition, by instituting paid parking it is possible to favour or discourage some user categories from parking in certain areas (e.g., commuters) and at certain times of the day.

However, parking pricing impacts not only parking subsystem, but transport and socioeconomic system of the city (Tsamboulas, 2001). In this regard, parking is seen as "an area of policy conflict since using it to manage demand may reduce revenue generation, or (be perceived to) damage the local economy" (Rye et al., 2008). Therefore, when defining parking price, it should be sought to balance incompatible goals of these systems.

Due to the significance of this subject many researchers have recently studied the impact of pricing on parking (transport) demand. The forecasts are based on a comparison of the demand at different parking prices. However, to perform these forecasts on a frequent basis, the researchers use data obtained from the use of stated preferences (SP) technique, i.e., users' statements regarding how they would behave if parking prices were increased to a certain level (see, for example, Simićević et al., 2013; Simićević et al., 2012a; Khodaii et al., 2010; Albert and Mahalel, 2006; Kelly and Clinch, 2006; Shiftan and Golani, 2005; Tsamboulas, 2001). Implementation of this technique is not expensive, it enables the interviewer to manage the conditions of a hypothetical journey precisely, and it is flexible (Tsamboulas, 2001). However, although useful in providing a preliminary estimate of the changes in demand, this technique also contains a number of problems that are inseparable from the way in which the data are collected–users need not necessarily behave in the way they stated they would. Furthermore, respondents can be led by the interviewers to offer an expected answer or they can provide a wrong answer on purpose realising that such an answer could affect the price formation (Kelly and Clinch, 2006).

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http://dx.doi.org/10.1016/j.tranpol.2015.11.007
0967-070X/

A small number of the surveyed responses to parking charges were also recognised by Vaca (2003). Vaca and Kuzmyak (2005) presented the results of price elasticity of parking demand, ranging from −0.1 to −0.3. However, even in this range, the values of price elasticity are more frequently estimated than surveyed. In a more recent review by Marsden (2006), in relation to the evidence for introducing parking policies, it was also concluded that there is a need to improve our understanding of the responses to parking policies in general.

Nevertheless, Tsamboulas (2001) observed that the answers provided by parkers in hypothetical situations are frequently realistic; still, if a credible forecast is to be produced, there is the need for data derived from real choices.

In any case, as previously mentioned, to achieve the set goals for introducing paid parking without any adverse impact on transport and other systems of a city when defining the price its effects must be predicted (Ibeas et al., 2011). In this context, setting the parking price on the basis of the adopted, desired parking occupancy (as a direct consequence of demand management) based on the SP must be verified by investigating the actual occupancy, i.e., the occupancy based on the revealed preferences (RP) of parkers once the parkers become accustomed to the new price.

Nevertheless, examples of studies based on RP data are rare, although there is an appeal to conduct such studies so that the findings obtained by the SP may be confirmed (Kelly and Clinch, 2009). The reason for the limited number of such studies is the absence of parking price changes (it is a relatively new measure) or, if a price change occurred, the absence of parking data before the change. The paper by Kelly and Clinch (2009) may be considered an exception. This paper explores the effects of a parking price increase by 50% for the on-street parking spaces in central Dublin, Ireland, based on "before and after" surveys. The results show that this increase caused a decrease in the demand for parking by 15% and shortened the parking duration by 16.5%.

Based on RP data, this paper also examines and quantifies the impact of the parking price on demand, as well as on the operation of parking garages in central Belgrade, Serbia. In addition, this paper investigates to what extent the planned demand, estimated on the basis of parkers' attitudes towards parking price, is in agreement with the actual demand after the price change. Confirmation of the agreement between the forecasted and actual demand would contribute to a greater reliability of achieving the expected effects based on the price determined through the forecasted demand and it would contribute to a better understanding of parkers' responses to parking policy in general.

The structure of the paper is as follows: Section 2 describes the methodology for the collection of the necessary data and quantification of the effects of pricing on parking demand. Section 3 presents and discusses the obtained results. Section 4 summarises the concluding considerations.

2. Methodology

The elasticity coefficient is commonly used to measure the impact of pricing on parking demand. This coefficient is defined as the percentage of change in the use of some commodity or service as a result of a 1% change in its price (TCRP, 2005). Knowing this coefficient enables us to predict the change in demand caused by a change in price (Simićević et al., 2012a).

"Arc elasticity" is most frequently used for the prediction of road users' behaviour. This paper will use linear arc elasticity, the formula for which is (Transit Cooperative Research Program, 2005):

$$\eta = (\Delta Q/((Q_1 + Q_2)/2))/(\Delta P/((P_1 + P_2)/2)) \quad (1)$$

where:

η–elasticity coefficient,
P_1–first parking price,
P_2–second parking price,
Q_1–parking demand at price P_1,
Q_2–parking demand at price P_2.

In this paper the data on parking demand at the first price (Q_1) was determined by the RP technique, whereas the parking demand at the second price (Q_2) was determined by both: (1) the SP technique when calculating the estimated value of the elasticity coefficient, and then (2) the RP technique when calculating the revealed or actually measured value of the elasticity coefficient.

A *T*-test was used to investigate the agreement of the value of parking performance characteristics obtained through the SP and then the RP method.

2.1. Study area

For the needs of this paper the survey was conducted in two parking garages in central Belgrade: the Pionirski parking garage and the Zeleni Venac garage. The Pionirski parking garage is a three-level underground garage with a total capacity of 472 parking spaces (25% of the total number of parking garage spaces in central Belgrade). The Zeleni Venac garage is an above-ground garage with eleven semi-levels having a total capacity of 304 parking spaces (16% of the total number of parking garage spaces in central Belgrade)[1]. Significant administrative-business and retail buildings are located in the garages' influential zone.

Central Belgrade covers an area of approximately 440 ha, comprised of approximately 96,000 inhabitants. The urban part of the city occupies an area of approximately 77,000 ha and has approximately 1.5 million inhabitants. The inhabitants of Belgrade make approximately three million trips per day. In the modal split, passenger cars account for 22% and public transport for 52% of all daily trips. The public transport network covers approximately 2.1 km/km^2; the headways are between 6 and 20 min. Public transport users rate the quality of service as very good (a score of 4 out of a maximum of 5) (Jović and Djorić, 2009).

In central Belgrade there are 13,791 public parking spaces, the majority (83%) of which are on-street parking spaces. There are five parking garages with a total capacity of 1,865 parking spaces, as well as eight off-street car parks with 510 parking spaces (Simićević et al., 2012a). All public parking spaces are owned by and are under the jurisdiction of the City Administration, which is also in charge of defining parking policy. The public utility company (PUC) Parking Servis is entrusted with the operation of all public parking spaces (on-street, off-street, and parking garages). This involves fee collection and parking enforcement. Private ownership and operation of public parking has not yet been introduced.

An established time limit and parking charge has been applied to on-street parking spaces in central Belgrade for more than 10 years (Milosavljević et al., 2003). Also, the city centre is divided into three parking zones that differ by zoning attributes: in the first (red) zone, parking is limited to 1 h and the parking fee is 56 RSD/h (0.49[2] EUR/h); in the second (yellow) zone, the maximum parking time is 2 h and the parking fee is 48 RSD/h (0.42 EUR/h); and in the third (green) zone, the parking is limited to 3 h and the parking fee is 41 RSD/h (0.36 EUR/h). This zoning is

[1] http://parking-servis.co.rs/eng/garages-and-car-parks/

[2] All values in Euros are calculated based on the exchange rate valid at the time this paper was written (1 EUR = 115 RSD).