Transport Policy 44 (2015) 89–95

Contents lists available at ScienceDirect

Transport Policy

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

Optimizing the use of public garages: Pricing parking by demand

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ARTICLE INFO

Article history:
Received 9 March 2015
Received in revised form
16 June 2015
Accepted 11 July 2015

Keywords:
Parking garage
Public asset management
Performance pricing
SF*park*

ABSTRACT

Many cities build public garages at great cost but with scant public scrutiny or economic analysis. Other than aiming to recover the cost of debt service and operations, cities appear to have few clear policy aims in managing these garages. In this paper, we outline how U.S. cities currently manage off-street parking structures under their control. We argue that this management largely ignores the logic of both economics and public benefits. We also make the conceptual case for how cities should manage their parking assets to maximize public benefits. Finally, we examine the most promising example of off-street parking public management, using data from 14 garages included in San Francisco's SF*park* program. We find that SF*park* increased the public use of garages by more than a third, reduced the average price for drivers, and maintained a stable revenue stream for the city.

1. Introduction

In 2011, San Francisco adopted the biggest price reform for public parking since the invention of the parking meter in 1935. San Francisco's parking prices for portions of both its public on-street and off-street supply now vary by time of day and by location. The goal for on-street parking is to charge the lowest possible prices that will leave between 20 percent and 40 percent of curb spaces open on every block at any time. The program attempts to achieve this aim by adjusting prices approximately every eight weeks. The goal for off-street parking is to leave some – but not too many – open spaces available in public garages at all times.

SF*park*, San Francisco's dynamic pricing program, aims to solve the problems created by charging too much or too little for public parking. If parking prices are too high and many spaces remain open, nearby stores lose potential customers, employees lose jobs, and governments lose tax revenue. If prices are too low and no spaces are open, drivers cruising to find an open space waste time and fuel, congest traffic, and pollute the air.

On-street parking spaces are part of the city's street system and have few ongoing maintenance costs after they are paved and marked. Nevertheless, cities that offer free or under-priced on-street parking to drivers incur a high cost for this mismanagement. Accordingly, a wave of recent research has demonstrated how cities can more effectively price on-street parking. The SF*park* program in particular has received much publicity for adjusting the prices at 7000 parking meters to achieve a target occupancy rate for on-street parking spaces (Chatman and Manville, 2014; Millard-Ball et al., 2014; Pierce and Shoup, 2013).

On the other hand, cities routinely build off-street parking spaces at great cost to the public, but with scant public scrutiny or scholarly analysis. Other than aiming to recover the cost of debt service and operations for the garages, cities appear to have few clear management goals. In the same SF*park* program that has made demand-responsive adjustments to on-street prices, San Francisco experimentally adjusted the prices of 11,500 off-street parking spaces in 14 city-owned parking garages. While the proportion of public off-street spaces subject to the experimental treatment is higher than for on-street spaces, no one has yet analyzed the off-street component of SF*park*.

In this paper, we first outline how U.S. cities currently manage off-street parking assets. We argue that the status quo of public management of these assets largely ignores economic logic. We next make the conceptual case for how cities should manage their parking assets to maximize public benefits. Finally, we compare the status quo to the most promising example of off-street parking public management using data from the 14 garages included in the SF*park* program. SF*park* represents a great improvement over the previous management regime. We find that SF*park* increased the public use of garages by more than one-third while marginally lowering the average price for drivers and maintaining a stable revenue stream for the city.

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http://dx.doi.org/10.1016/j.tranpol.2015.07.003
0967-070X/

Both our conceptual model for optimal off-street parking policy and the findings from SF*park* suggest practical steps that cities can take to improve outcomes for both municipalities and residents. These steps are cheap and logistically simple compared to on-street reforms. The principles of demand-sensitive parking management can also be easily extended to non-city off-street spaces. Despite their importance, analyses of public off-street management are scant compared to the literature assessing public on-street parking. We conclude this paper by outlining a future research agenda for off-street studies, including making use of more detailed occupancy data than are available in the on-street context.

2. Optimal pricing policy for public garages

Whether on-street or off-street, managing parking well presents a challenge because parking space is a perishable good. Perishable goods have fixed, sunk costs and their value cannot be stored. Perishable goods thus require careful management to ensure their efficient use (Kimes, 1989; Weatherford and Bodily, 1992). Other prominent examples of perishable goods include airline seats, hotel rooms, and advertising time on television.

Effective management for perishable goods has three essential components. First, the good must be sold within a limited time period. Seats on airplanes or rooms in a hotel, for example, are either used by a fixed deadline or wasted; these assets cannot be resold later. The use of parking space is similar. Second, perishable goods have a fixed number of units. Regardless of demand, new parking spaces cannot be manufactured quickly or cheaply. Finally, perishable goods are optimally managed either by charging different prices for the same product at different times, or for different people at the same time. This strategy of price differentiation is already common practice in the parking industry, as evidenced by the lower rates often offered to early birds or to nearby shop customers through validated parking. Yet the techniques employed by managers of public parking garages have lagged significantly behind the more sophisticated private parking operators (Akhavan-Tabatabaei et al., 2014; Guadix et al., 2009). Private operators set prices for perishable goods to yield the maximum revenue, which is why the science of pricing perishable goods has come to be called yield management. A city's goal, however, should be different. A city should try to optimize the use of public garages, rather than to maximize the revenue.

Cities typically follow one of three approaches to set the prices for parking: they (1) price at the marginal cost, regardless of the market rate, (2) price at the market rate, regardless of the cost, or (3) price to reach a revenue goal.[1] The policy of providing free on-street parking represents the first approach. For decades, planners naively assumed that there was no cost to recoup from the use of on-street space. Demand-responsive pricing exemplifies the second approach. Market-priced curb parking can generate considerable revenue for a city if the price exceeds the collection and maintenance costs. SF*park* explicitly targets optimal occupancy—not maximum revenue—when setting prices, yet the program's revenue has remained almost unchanged even as prices varied to optimize occupancy.

For off-street parking spaces, cities commonly set revenue goals. This strategy may seem appropriate because cities incur high costs to build and operate garages. A recent study in 12 American cities found that public garage construction costs averaged $24,000 per space for aboveground structures and $34,000 per space for underground garages (Shoup, 2011). Parking prices high enough to recoup these construction costs can leave substantial vacancies. Private garages can maximize profits despite substantial vacancy rates when they face inelastic demand. While not all private firms maximize profits in practice, their primary incentive is certainly to earn profit. [2] If the capital and operating costs of a parking lot are fixed, the owner can maximize revenue and profits at the occupancy rate where reducing the price to attract additional customers produces no additional revenue, even if many spaces remain vacant.

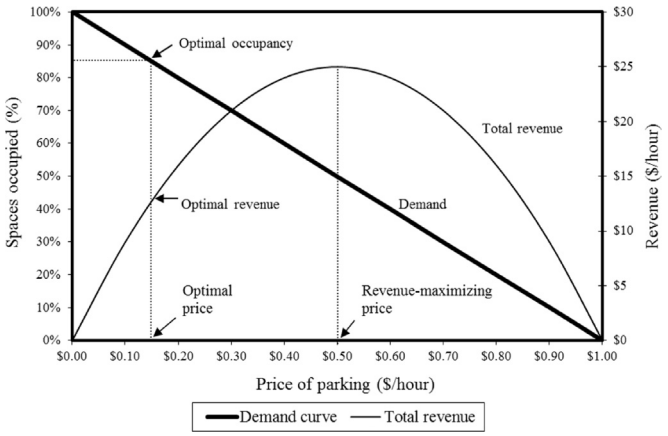

Fig. 1. Parking prices, occupancy, and revenue.

Fig. 1 illustrates how a 100-space garage can maximize revenue with only a 50 percent occupancy rate (adapted from Shoup, 2011). Price is on the *X*-axis, and the demand curve slopes downward. The garage is full when the price is zero, and has zero occupancy when the price is $1 an hour. Maximum revenue, $25 an hour, occurs at a price of $0.50 an hour ($0.50 × 50 occupied spaces = $25). But leaving half the parking spaces vacant is not optimal for a public garage. A parking system operates most efficiently at an occupancy rate between 85 and 95 percent of capacity, so entering cars don't have to circle through the entire garage to find a vacant space. If a city aims for an 85 percent occupancy rate to manage the parking supply efficiently, the garage would price parking at 15¢ an hour, yielding a total revenue of $12.75 an hour ($0.15 × 85 occupied spaces = $12.75). Therefore, pricing parking to achieve efficient occupancy generates only about half the maximum total possible revenue.[3]

[1] Kenneth Button (1977, p. 43) says, "In practice, two quite distinct types of charging policy for parking spaces may be discerned: There is an administrative approach and an economic one. The former is concerned with cost recovery and is closely entwined with the highway engineer approach to urban traffic problem. The economic way is to regulate charges in sympathy with the prevailing state of demand in the say way that other commodity prices vary. Charges are therefore based on the 'willingness to pay' principle." In addition to these two approaches, some cities have a revenue goal to cover the debt service and operating costs of public garages.

[2] Epstein (2001, p. 25) states that "Presumably, the ideal system [of charging for curb parking] is one in which the City maximized its revenue from use." Unfortunately, this confuses a city's goals with those of commercial parking operators, which theory suggests will aim to maximize profits, not social benefits. If the goal of pricing curb parking is to achieve a 15 percent vacancy rate, higher prices and a lower occupancy rate can increase revenue but leave too many spaces empty.

Commercial parking operators have downward-sloping demand curves because they are in "monopolistic competition." If all costs are fixed regardless of the occupancy rate, the owner will maximize revenue and profits at the price where demand is unit elastic. If demand is inelastic (less than unity), raising prices will increase revenue and profits. If demand is elastic (greater than unity), reducing prices will increase revenue and profits. If costs are fixed, maximum profits will accrue only at the price where the elasticity of demand is unity. At times when the maximum revenue is less than the operating cost, the parking lot will close.

[3] A 2003 survey of parking in downtown Los Angeles found that the occupancy rates of off-street parking lots and garages was only 38 percent on Saturday afternoon, and only 10 percent on weekday evenings (Kimley-Horn and Associates, 2003). A parking survey in Tempe, Arizona, found that only 52 percent of spaces were occupied on a Friday evening when on-street parking was hard to find (Minett 1994).