The Role of SpotHero and Other Online Reservation Platforms in Facilitating Dynamic Pricing for Off-Street Parking: Evidence from Chicago, Illinois

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ABSTRACT

Online parking reservation platforms, such as ParkWhiz and SpotHero, are changing the manner in which many consumers purchase off-street parking. This study compares the manner in which parking is priced on the SpotHero platform with more traditional payment methods to gain insight into the potential role of these platforms in making the allocation of parking more efficient. Using a data set encompassing 6,140 prices at 502 facilities in Chicago, Illinois, it shows that many parking facilities participate on SpotHero only sporadically and are most apt to participate during times when excess capacity is available. Average prices are roughly 25 percent lower than for drive-up purchases and those on the official websites of the facilities, but are also much more dynamic. Between the late afternoon and evening time periods evaluated, for example, SpotHero prices changed at 35 percent of the facilities sampled, compared to 22 percent for drive-up purchases and 8 percent on official pre-purchase websites. Prices also fluctuate three times more from day to day than they do for these other purchasing options.

The results suggest that parking reservation platforms are instruments for dynamic pricing and market segmentation that hold promise for increasing parking utilization. These platforms also have potential to support the movement to create "Smart Cities", i.e., places relying on advanced technologies to promote the efficient use and maintenance of infrastructure. Their growing popularity, however, also raises issues for policymakers, such as whether to negotiate to request data from reservation platforms, perhaps in anonymized form, for policy analysis.

INTRODUCTION

The emergence and expansion of online parking reservation tools, such as ParkWhiz and SpotHero, gives consumers new options for finding and purchasing off-street parking (Chowdhry, 2013; Marotti, 2018). These app-based tools, managed by private third-party companies working on a commission basis, facilitate comparison shopping, provide guaranteed parking spots upon arrival, and enable buyers to easily switch between payment options. Both commuters and leisure travelers who previously had made drive-up parking purchases are now using these platforms in increasing numbers.

This study evaluates listings for parking facilities on SpotHero in Chicago, Illinois to better understand the degree to which these platforms help foster the efficient allocation of parking. It begins with a review of common problems associated with off-street parking in cities before summarizing some of the strategies involving dynamic pricing that are being employed to alleviate these problems. The study then analyzes the prices and availability of SpotHero and more traditional payment methods to assess some of the notable differences between these buying options. This allows for an assessment of the degree to which prices are dynamically adjusted in response to changing supply and demand.

Two sources of data are used for statistical analysis: (1) a data set encompassing prices at different points in time for 502 parking facilities with listings on SpotHero.com in Chicago; and (2) a sample of drive-up and online reservations on websites maintained by 142 parking facilities over the same time period. Cumulatively, these data sets encompass 6,140 prices.

The conclusion section explores whether online parking reservation platforms, by making prices more dynamic, are helping to more closely align the private interests of parking facility operators (which primarily seek to maximize profit) and the public interests of government entities. These public interests might include mitigating congestion and lessening emissions, reducing the special footprint devoted to off-street parking, and creating incentives to encourage travelers to make informed decisions when choosing a mode of travel. This section concludes that third-party parking reservation should be regarded as a tool that can help advance “Smart City” policies, i.e., those which draw upon real-time data to encourage the efficient use of scarce resources in metropolitan regions.

RESEARCH ON MUNICIPAL STRATEGIES IN PARKING ALLOCATION

A great deal of research exists about the amount of parking needed to meet the demand in urban and suburban situations in which parking is provided to motorists for free. The widely circulated publications by the Institute for Traffic Engineers, for example, offer detailed recommendations about the amount of parking necessary to accommodate various amounts of commerce and residential and retail development. These tools have long guided policymakers in designing parking facilities to support new construction and redevelopment projects. Nevertheless, they tend not to extensively consider the possibility of using pricing or other market incentives to temper demand.

McShane and Meyer’s “Parking Policy and Urban Goals: Linking Strategy to Needs,“ stands out as among

the first studies to expound upon the complexity of optimizing parking decisions for the benefit of society as a whole (McShane & Meyer, 1982). The researchers identify six urban goals, which involve encouraging: (i) a healthy economic climate; (ii) the most efficient use of existing transportation, land, and other public resources; (iii) ease of mobility and accessibility of resources; (iv) equity of resource distribution and preferential allocation of some resources; (v) environmental goals, especially reduced air pollution and the related goal of minimized energy consumption; and (vi) enhanced amenities and cultural attractiveness. Their analysis makes clear that municipal parking policies should be about much more than estimating the amount of parking needed when it is allocated on a first-come-first-served basis.

Municipal governments have struggled to make decisions about the supply and price of parking with the diverse goals identified by McShane and Meyer in mind. Much of this research focuses on the problems that emerge when prices are set too low or when nothing is charged at all. Donald Shoup makes the case in *The High Cost of Free Parking* (2007, and updated in 2011) that municipal policy often falls well short of achieving even the simpler goals of preventing surpluses and shortages of parking. Many units of governments, he argues, have lacked the political will, resources, or technology to efficiently price and manage public lots, garages, and on-street spots. Often, prices at municipally owned parking facilities and spaces are set too high, which leaves valuable inventory unused, or too low, which results in chronic shortages. These problems, magnified by the difficulty of conveying real-time information to motorists about availability, results in ill-advised trip decisions, illegal parking, or roaming around in search for spots. Shoup cites evidence showing that in some urban neighborhoods, more than half of the vehicles on the street can be circling blocks looking for available on-street parking. In Los Angeles, the average cruising distance was estimated to be about half a mile (Shoup, 2011).

Other problems preven*t privately owned parking facilities* from allocating spaces in a manner that maximizes community benefits. The desire for owners to maximize profits without regard to non-market factors that are important to communities can result in lower-than-optimal occupancy levels (McShane & Meyer, 1982). Valuable spaces can go unused, thereby missing opportunities ranging from improving job access to stimulating retail sales and cultural activity in downtown districts. Pierce, Wilson, and Shoup show that profit-maximizing occupancy rate in private garages can be as low as 50 percent (Pierce et al., 2013). Occupancy rates above 80 percent are often considered undesirable due to such factors as difficult-to–predict demand fluctuations and the need to make finding a spot relatively easy when entering a parking facility. In fact, when rates exceeded 90 percent, Millard-Ball et al. found through simulation analysis for San Francisco that cruising for spots becomes increasingly common (Millard-Ball et al., 2014). Conversely, when rates fall below 60 percent, parking is underutilized.

Another problem identified by the Pierce et al. article relates to the difficulty for motorists to easily comparison shop. Many facilities profit by “selling convenience” and thereby benefit when the search costs facing motorists are high. The result can be that motorists spend more money than necessary to park, take fewer trips, and roam more excessively in search of lower-cost options. When comparison shopping and advance reservations are difficult, many motorists respond by habitually using the same garage on every trip, which makes the parking market less fluid than many other types of purchases.

Many cities are taking steps to foster more efficient allocation of municipally owned facilities through

enhanced data collection and dynamic pricing. San Francisco, for example, has adopted the SFPark program, in which sensors adjust pricing at its 14 public garages (Pierce et al., 2013). The same Millard-Ball study mentioned earlier estimates that San Francisco's adaptive parking pricing program reduced cruising by 50 percent relative to other control blocks outside of the program. Omaha, Sacramento, and Seattle have sophisticated pricing systems that include such innovations as tired pricing fees based on demand and charging less for the first two hours than the subsequent hours in order to maximize turnover (Nelson Nygaard et al., 2019). Philadelphia's "meterUP app" also has a dynamic quality and enables mobile payment at kiosks.

Chicago has taken notable but less dramatic steps to make parking more reflective of supply and demand conditions. Privatization of the city's publicly owned garages in 2006 resulted in rates being scaled more closely to demand, although not in a highly dynamic manner. In 2008, the city privatized its on-street parking facilities, which, while widely criticized both for its financial aspects and the obstacles it has created for redevelopment initiatives, allows for more peak-demand pricing (Lipkin, 2017). Municipalities have fewer policy options to improve the community benefits generated by *private parking garages* because pricing is independently determined. Most cities have moved away from dollar-amount taxes toward percentage-based taxes, which make the amount paid higher in peak conditions than at other times. Some cities have scaled tax rates to encourage increased use of garages at off-peak times. Chicago, for example, discarded its flat dollar-amount tax in favor of a two-tiered percentage rate, which is 22 percent on weekdays but only 20 percent on weekends.

The growing pervasiveness of third-party platforms like ParkWhiz and SpotHero has helped reduce the uncertainty facing traveling when making trip decisions (Chowdhry, 2013). Motorists can search available options and reserve a spot minutes or days in advance. ParkWhiz, founded in 2006, has grown to around 50 major cities, in part due to the acquisition of the much-smaller BestParking in 2015. SpotHero, founded in 2011, expanded with the acquisition of the much smaller Parking Panda in 2017, and subsequently grew to serve 47 North American cities (Jackson, 2017). Smaller players include Honk and Parkopedia (Delbridge, 2018). Purchases can be made on a platform's smartphone app or website, and the user is required to present a barcode to validate their purchase at the parking facility.

METHODOLOGY

The statistical analysis uses a panel data set assembled from two sources. First, using an online data query, prices of 502 parking facilities listed on SpotHero for parking on June 24, 2019 and July 31 – August 4, 2019 were collected, with advance purchases ranging from three to seven days. Data were collected for different scenarios, varying by time of day and number of days purchased in advance. Altogether, this data set encompasses 3,820 prices.

The second and smaller sample of prices encompasses prices for *drive-up purchases* and online reservations on the official websites maintained by the parking facility operators or their corporate affiliates (Table 1). The same variables and time period were used for this data set, which encompasses 142 facilities and 2,320 prices. Careful consideration was given to distinguish these "official" sites from third party sites—a distinction that might not always be clear to consumers. Purchases over these

websites are referred to as *pre-purchases*.

The prices from the two data sets were matched for comparative purposes. To allow for a systematic review of prices, the analysis focused entirely on five three-hour time periods: 6 – 9 a.m., 9 – noon, noon – 3 p.m., 3 – 6 p.m., and 6 – 9 p.m. Although this limits the analysis to purchases of short duration, it allows for more nuanced assessment of how prices fluctuate over the course of a day than would be possible when reviewing longer time periods. Future analysis is planned to explore how prices differ based on the duration in which the vehicle is parked.

TABLE 1: Three Types of Purchases in Data Set of Parking Prices

Type of Price	Definition	Notes/Limitations	Cumulative Number of Pricing Observations
Drive-up	Prices for motorists driving up without a reservation. This typically involves payment upon entry or exit.	These prices are typically posted on the website of parking facilities. Some facilities have higher prices during special events that are not reflected in posted rates.	1,420
Pre-purchase on official website	Price, including fees, for buying on a website affiliated with parking facilities.	This option is available at facilities that have invested in these websites (estimated to be 40% for facilities in sample).	900
SpotHero	Prices on SpotHero.com. No fees were applied to purchases made during the sample period.	Purchases can be made on smartphone app or website. This option is more sporadically available than the other buying options.	3,820

ANALYSIS

Comparative analysis of prices between parking facilities allowed for several notable findings. The terms *rates* and *prices* are used interchangeably when summarizing the results.

FINDING 1. Nearly all parking facilities charge the same prices for drive-up purchases each weekday, although, generally, there are considerable time-of-day differences. Only about 40 percent of the facilities sampled have official websites that allow for pre-purchases. Overall, the results suggest that the development of internal systems for dynamic pricing remains limited.

Most parking facilities have prominent signage visible to motorists upon entry, and have sections on their websites clearly indicating rates for drive-up and pre-purchase transactions. Although these prices are generally the same for any weekday (prices on Wednesday, for example, tend to be the same as those on Friday), there is wide fluctuation for drive-up purchases over the course of the day. In the

morning, prices tended to be lower in part due to “early bird” discounts, i.e., special prices for those who arrive (and leave) by a certain time. Many facilities also have late-afternoon and evening specials for drive-up customers.

Drive-up prices rise through late morning (partially due to the diminishing relevance of early-bird discounts) and fall during the course of the afternoon. Average prices peak at $28.96 during the noon – 3 p.m. period and then fall to $25.08 during 3 – 6 p.m. and to $22.63 during the 6 – 9 p.m. (Table 2). Between five successive three-hour time periods sampled over the course of the day on July 24, 2019, prices for drive-up purchases changed 29 percent of the time.

A possible explanation for the comparatively low early-morning prices is the heightened price sensitivity of commuters who make the same trip each weekday. Such repeat customers have a greater incentive to comparison shop and obtain recommendations from coworkers or friends, which results in more acute competition for early morning arrivals. Moreover, early birds typically leave early enough so that other customers can use the space later in the day.

Only about 40 percent of parking facilities have the capability for pre-purchases on official websites, and those that have them usually do relatively little to publicize them. Prominent signage alerting motorists to these websites is rare, and websites are typically not printed on receipts. In this respect, parking facilities differ sharply from airlines and hotels, which go to considerable lengths to encourage customers to go directly to their websites. Many parking facilities are part of networks that operate under the same brand name, such as Interpark, Hunter, LAZ, Legacy, and Park 1, and share a common website.

TABLE 2: Pricing Differences Between Drive-Up Sales and Pre-Purchases on Official Websites
Three-hour time periods; for Parking on Monday, June 24, 2019

	6am – 9am	9am – 12pm	12pm – 3pm	3pm – 6pm	6pm – 9pm	Overall
Drive-Up	$18.97	$25.94	$28.96	$25.08	$22.66	$24.74
Pre-Purchase	$17.10	$17.03	$19.11	$17.72	$17.31	$17.74
Pre-Purchase Savings	-9.9%	-34.4%	-34.0%	-29.4%	-23.6%	-26.2%

N = Sample of 142 parking facilities

Motorists who pre-purchase parking on official websites save an average of 26 percent compared to drive-up purchases, which, as with early birds, is likely due to their heightened ability to comparison shop. The savings from pre-purchasing is smallest during early morning, when it is just 10 percent,

largely due to the prevalence of these morning specials for drive-up customers. Pricing on pre-purchase websites is *higher* less than five percent of the time over the course of the day.

Another notable—and in some ways, surprising, difference—is the lessened *intraday variation* on pre-purchases. In only seven percent of the cases did the prices for pre-purchases change from one three-hour block to the next, regardless of whether it involved the morning, afternoon, or evening. Such static pricing may be due to a variety of factors, including: (i) the relatively primitive design of these reservation systems, which may not have functionality for sophisticated pricing arrangements; (ii) a belief that the heightened demand elasticity of pre-purchase customers reduces opportunities for more complex pricing schemes; or (iii) a desire to avoid requiring customers to concern themselves with the hassle of arriving and departing at particular times, which can add stress to the purchase, especially for those who have long drives (a topic discussed in greater detail below). Regardless of the reason, it is clear that parking facilities have not invested heavily in official websites for the purpose of instituting a great deal of intraday pricing variation.

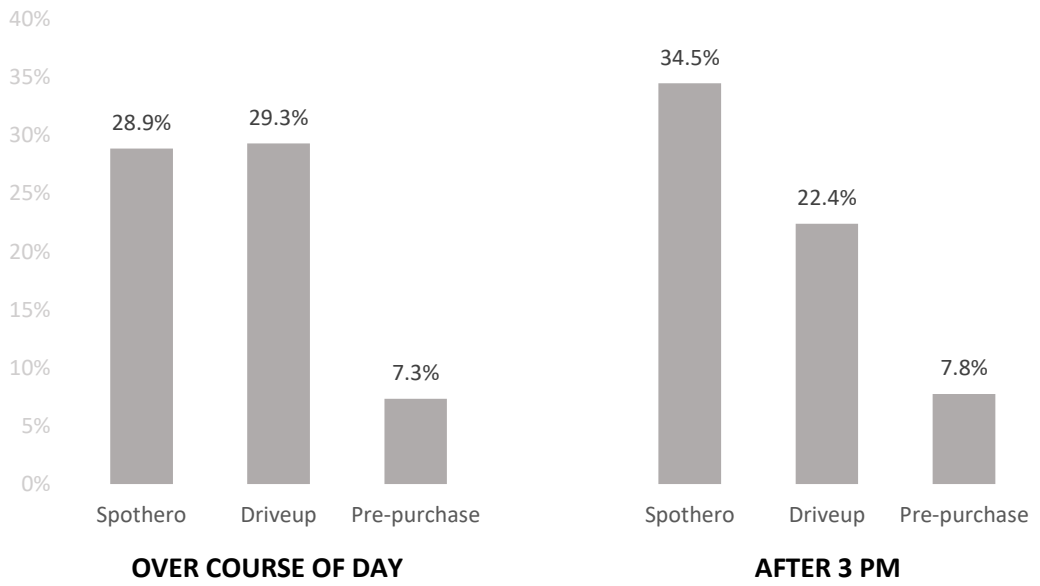
FINDING 2. Many parking facilities that participate on SpotHero do so only sporadically and are most apt to participate during late afternoons and evenings, when they are likely to have excess capacity. Moreover, prices on SpotHero are more dynamic than on pre-purchase websites over the course of the day. After 3 p.m. on any given weekday, between successive weekdays, and between weekdays and weekends, they are much more dynamic, changing with far greater regularity than prices for drive-ups and pre-purchases.

Individual parking facilities tend to regularly appear and disappear on SpotHero, apparently in accordance to demand conditions. On June 24, 2019, for example, the number of facilities listed grew from 267 in the 6 – 9 a.m. period to 341 from 12 – 3 p.m., before growing to 391 between 3 – 5 p.m. and 422 from 6 – 9 pm, a 58 percent increase compared to the first period. Among the entire 502 facilities that appeared over the course of the day, only about 68 percent were present during all five time intervals considered. About one in seven (15 percent) first appeared on SpotHero during the 3 p.m. period and then remained on it for the duration of the day.

This pattern suggests that many parking facilities turn to SpotHero only when they need to dispose of unused capacity. Nearly all of the official pre-purchase sites, conversely, had spots available during *all* five time periods, suggesting that they are not used in the same manner.

Between the three-hour time periods over the course of the day, SpotHero and drive-up prices fluctuated with much regularity, in each case changing 29 percent of the time, whereas prices on pre-purchase sites changed only seven percent of the time (Figure 1). Between the 3 – 6 p.m. and 6 – 9 p.m. periods, SpotHero prices changed 35 percent of the time, whereas drive-up and pre-purchases changed 24 and eight percent of the time, respectively.

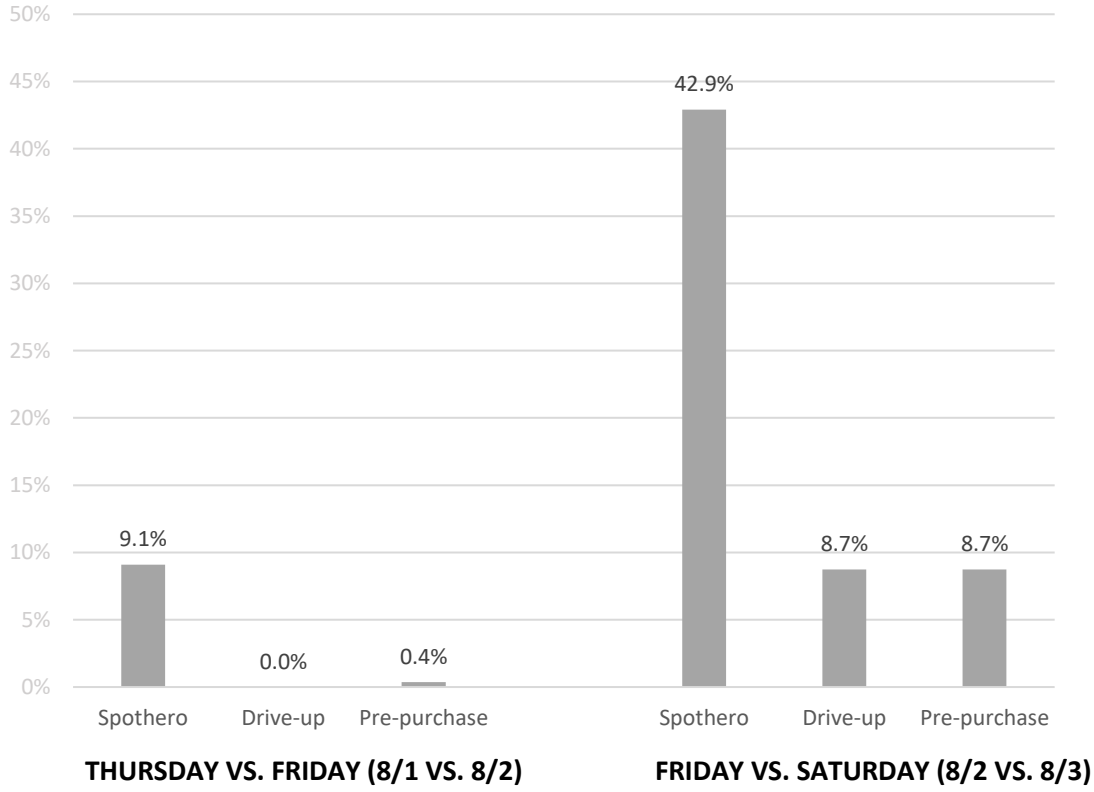
FIGURE 1: Percentage of Time the Price Differs Between Successive Time Periods on Same Day
Three-hour time periods; for parking on Monday, June 24, 2019



N = Sample of 142 parking facilities

Similarly, from one day to the next, SpotHero prices tend to change far more often than either drive-up or pre-purchase prices. In a sample of 130 facilities observed in late July 2019 for parking on Thursday, August 1, 2019 and Friday, August 2, 2019, SpotHero prices during the 3 – 6 p.m. period differed in nine percent of the cases, whereas drive-up and pre-purchase rates were identical in all or nearly all cases. When comparing Friday, August 2 and Saturday, August 3, SpotHero prices differed in 43 percent of the facilities observed, whereas drive-up and pre-purchase prices differed only 8.7 percent of the time. This suggests that SpotHero prices are much more likely to be adjusted to account for variation between weekdays and between weekdays and weekends. Conversely, the share of facilities that changed prices between Saturday, August 5, and Sunday, August 6 was similar for all three purchase options, although the amount of the price change was largest on SpotHero.

FIGURE 2: Percent of Facilities with Different Prices on Successive Days
For parking from 3 – 6 p.m., August 1 – August 3, 2019



N = Sample of 142 parking facilities

It is not uncommon for official websites to clearly specify the circumstances that might cause them to change prices for drive-up purchases from one day to the next. This can include special events (such as major sporting events, political rallies, and when similar gatherings occur). A minority of facilities offered lowered prices during summer, apparently due to a reduction in commuter parking. Some offer discounts for patrons validating their tickets at restaurant or theaters. SpotHero prices, conversely, appear to change in more unpredictable ways.

FINDING 3: SpotHero rates are significantly lower than both pre-purchase and drive-up prices, but are more tightly clustered around the sample mean.

Across all five time intervals considered, average SpotHero prices (when a price was listed for a particular facility) were 40 percent lower than corresponding drive-up prices and 17 percent lower than pre-purchase prices. After 6 p.m., SpotHero prices, when available, are 43 percent lower than drive-up purchases and 25 percent lower than pre-purchases (Table 3a).

TABLE 3: Average Price, SpotHero vs. drive-ups and pre-purchases
Three-hour time periods; for parking on Monday, June 24, 2019

Weekday Rate	SpotHero (when available)	Pre-Purchase	Drive-Up	% Savings vs. Pre-Purchase	% Savings vs. Drive-Up
a) Average Prices					
Entire Day	$14.79	$17.74	$24.74	-16.6%	-40.2%
After 6 p.m.	$13.04	$17.31	$22.66	-24.7%	-42.5%
b) Interquartile Range (Examples)					
3 – 6 p.m.	$14 - $17	$15 - $23.5	$27 - $35		
After 6 p.m.	$13 - $16	$14.5 - $27.5	$20 - $33		

N = Sample of 142 parking facilities

Several microeconomic factors appear to underlie these differences. As previously noted, SpotHero consumers are better able to comparison shop. Another factor may be that operators of parking facilities may deliberately set prices at a premium in order to give customers making drive-up purchases—or buying on the official website—a high degree of predictability with respect to price and availability. Much like airlines hold high-price seats for "walk up" customers, but tend not to raise them above a certain maximum level, parking facilities may "sell convenience" by establishing premium prices for drive-up customers who seek to avoid committing in advance. In this way, parking providers may seek to cultivate a predicable experience among their customers, some of whom may resent parking highly opportunistic pricing.

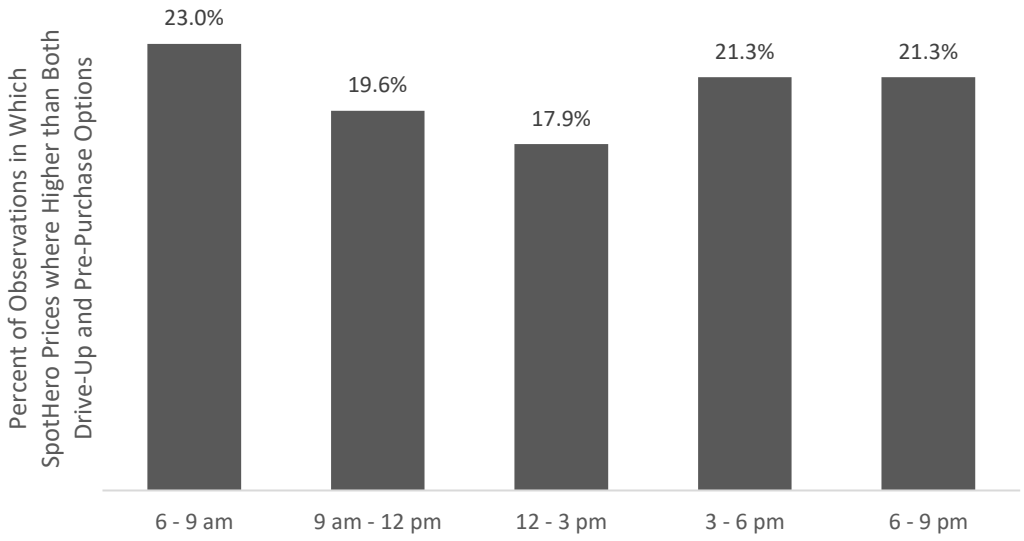
These results support the notion that parking facilities use SpotHero in the same way that restaurants use Groupon and other third-party outlets to engage in multi-party pricing rather than adjusting menu prices. Offering sporadic discounts on third-party sites helps alleviate supply-and-demand imbalances without appearing to be "exploitative" to regular customers.

Such multi-party pricing is facilitated by the restrictions often placed on SpotHero customers, which are frequently more stringent than those imposed on pre-purchases made on official websites. Customers buying on official websites can usually arrive and depart with considerable flexibility, as long as the duration of their stay does not exceed the length of time purchased. SpotHero customers, however, are required to arrive and depart during more tightly defined intervals, or else pay a higher fee when exiting. Much as airlines segment the market by imposing restrictions on fares, SpotHero requires customers to commit to particular arrival and departure times (generally within 15 minutes of the time on the reservation).

FINDING 4: Parking facilities tend to view parking booking intermediaries as serving a different market segment than their drive-up and pre-purchase customers. SpotHero prices, for example, are rarely the same as those on pre-purchase websites, and are higher in about one-fifth of the instances observed. Moreover, the dispersion of prices is much lower on SpotHero than for drive-ups and pre-purchases.

Many customers reserving spaces on SpotHero are apparently unaware of the drive-up and pre-purchase prices at the facility they chose. In fact, on the day the sample was taken, SpotHero prices are *higher* between 17 – 23 percent, depending on the time of day (Figure 3). Such premium pricing is particularly prevalent in the morning, dips during mid-day, and then rises again during the evening.

FIGURE 3: Percentage of Observations in which SpotHero Prices were Higher than both Drive-up and Pre-Purchase Options



Another distinction is that SpotHero prices tend to converge around the mean for all parking facilities listed on the platform to a much greater extent than drive-ups and pre-purchases. During the noon – 3 p.m. time period, for example, the interquartile range for SpotHero is $14 – $16, whereas it is $27 – $35 for drive-up purchases and $19 – $24 for pre-purchases (Table 4b). The results were similar during other time periods. Apparently, the parking facilities feel greater pressure to set prices on SpotHero closer to the prevailing rate in their part of the city than for drive-ups and pre-purchases.

CONCLUSION

SpotHero and other third-party reservation platforms are instruments for more dynamic pricing. These platforms also give managers opportunities to charge different prices to different types of customers in order to increase utilization rates. Furthermore, they give private facilities abundant data on the availability and prices of competitors, which allows them to avoid inefficient pricing decisions resulting

in prices being too high or too low, which can engender surpluses or shortages.

More research is needed to better understand the degree to which these platforms increase the utilization of parking. It appears that these platforms help align the private decisions of parking operators most closely with the public good by more effectively balancing supply and demand than more traditional purchasing methods. In this way, they can augment innovations related to movement to create "Smart Cities" (i.e., places relying on advanced technologies to promote the efficient use and maintenance of infrastructure).

The growing popularity of reservation platforms also raises important issues for policymakers, such as whether to negotiate to request data from reservation platforms, perhaps in aggregate and anonymized form, for public analysis. Another issue is whether to maintain different levels of taxation for parking facilities and commissions paid for using the third-party reservation platforms, which are less heavily taxed. (In some cities, taxes consume more than a third of the fees paid for parking.) The application of taxes to commissions paid for use of reservation apps such as ParkWhiz and SpotHero could reduce the number of facilities that participate on the platform, making pricing less dynamic.

Another notable implication of the expansion of these platforms is the heightened attractiveness of adopting more sophisticated tax schemes that create incentives for lessening congestion and resolving other problems. One can envision tax rates for private facilities that vary in a manner comparable to the dynamic prices at public garages in San Francisco. Although dynamic taxation may be highly problematic for drive-up purchases by reducing predictability for the drive-up motorist, thereby encouraging roaming and illegal parking when prices exceed their willingness to pay, they could be an effective instrument for sales on booking platforms in which customers reserve spots before arriving at their intended destination.

Interpreted broadly, the expansion of third-party parking reservation platforms deserves more attention as a "Smart City" strategy to increase efficiency, enhance the user experience, and lessen congestion.

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