UNIVERSITY PARKING: A PERCEIVED PUBLIC GOOD IN A REVENUE CONSTRAINED ENVIRONMENT

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ABSTRACT

Parking Management Units (PMU) at the vast majority of university campuses in the United States represent a self-sustaining auxiliary unit. Given the decline in state financial support for many higher education institutions, PMUs are increasingly being pressured to maximize revenue while at the same time managing what is very often perceived by users as a public good. Maximization of revenue requires a clear understanding of price sensitivity across target markets. This is especially true in instances where substitutable products offered by a single purveyor exist, such as different types of parking permits offered by a single institution. The primary objective of this research is to assess the price sensitivity of various target markets with respect to university parking at a mid-sized, state-funded university located in the Inland Northwest of the United States (University of Idaho). Utilizing data collected from a conjoint survey of administrators, faculty, staff, and students, price sensitivity is assessed by estimating the demand function for various types of parking permits. Furthermore, the degree of substitutability between various permits types is evaluated by calculating cross-price elasticity of demand. Results from this research can provide managers with insight regarding the pricing dynamics in a university parking setting and allow for more efficient pricing of parking permits.

Keywords: campus parking, conjoint analysis, higher education, pricing strategy

INTRODUCTION

Campus parking has long been a pressing issue for universities, both domestically and internationally (Bennett, 1956, 1958; Forman, 1971; Meng, Du, Li, & Wong, 2018; Mooney, 1993; Narragon, Dessouky, & DeVor, 1974; Pendakur, 1968; Sandland, 2006; Tezcan, 2012; van der Waerden, Borgers, & Timmermans, 2006). The persistence of the campus parking problem has accordingly led to several entertaining comments and strategic decisions. For instance, Clark Kerr, former president of the University of California system, publicly stated at the inaugural ceremonies for the new president of the University of Washington, Charles E. Odegaard, that "I find that the three major administrative problems on a campus are sex for students, athletics for alumni and parking for faculty" (Anonymous, 1958). Kerr also remarked during a Godkin lecture at Harvard University that "I have sometimes thought of the modern university as a series of individual entrepreneurs held together by a common grievance over parking" (Kerr, 1966, p. 20).

In a similar vein, a former president of Dartmouth College, David McLaughlin, once quipped that the issue that kept him up at night was "…the fear that everyone with a parking permit will show up at the same time" (Anderson, 1996). When the University of Manchester, in England, inquired of Andre Geim, co-recipient of the 2010 Nobel Prize in Physics, as to what would

persuade him to stay at the institution rather than seek employment elsewhere, Dr. Geim's singular request was for a parking space located near his building on campus; the university subsequently granted his request (Troop, 2011).

The persistence of the campus parking problem is likely due to the fact that many university stakeholders view university property that is dedicated to parking as a public commons, while others view parking as being a requisite entitlement or benefit for either enrollment or employment (Anonymous, 2004; Bennett, 1956; Ehrenberg, 2000; Farrell, Mahony, & Caulfield, 2005; Grubb & Oyer, 2008; Schmidt & Westley, 2010; Tudela-Rivadeneyra, Shirgoaker, Deakin, & Riggs 2015). Many university parking policies and permit price levels are therefore made in response to the complaints and idiosyncratic wants of university community members rather than based on market forces and data derived from marketing research (Anderson, 1996; Barata, Cruz, & Ferreira, 2011; Rye, Hunton, Ison, & Kocak, 2008; Wang & Zhou, 2010). Thus, as Shoup (2008, p. 122) has observed: "Universities often lead societies in advocating social and economic equality, but their complex parking hierarchies make the *Titanic* look like a one-class ship."

The complexity of campus parking policies and permitting methods is difficult for many stakeholders to comprehend. In fact, courts have described the operating environment of one campus parking organization as being a "corrupt, Machiavellian world" (Stevens, 2007). And when changes to parking policies and permitting methods are made by parking management units (PMUs), they are often perceived as oppressive (Kelly, 2015; Mooney, 1993; Sandland, 2006; Shoup, 2008).

Nevertheless, university PMUs are being pressured to maximize revenue from parking permit fees in order to be self-sufficient, to maintain and enhance current parking facilities, and to increase parking capacity due to growing student enrollments (e.g., Bridgelall, 2014; Chance, 2006; Gadsby et al., 2003; Jeppesen & Dorsett, 2014; Millard-Ball, 2004; Shaheen & Khisty, 1990; Smith, 1994). After review of parking fee management at a number of campuses, it is evident that even in a period of declining state support and tight budgets that public universities have, as a general rule, been extremely hesitant to maximize the potential revenue of their parking asset.

The paper begins by surveying the literature as it pertains to parking on university campuses. In particular, we examine the campus parking issues that have been noted in the literature and some proposed solutions that address these parking issues. We then present a data-driven case study that assesses a solution not yet proposed in the literature. Specifically, we assess demand elasticity for campus parking utilizing an auction allocation system. Finally, we discuss the results of the case study, the implications for PMUs, limitations of our research, and proposed future work that could be conducted to better understand the pricing of campus parking.

LITERATURE REVIEW

A small but growing body of research has developed attempting to address the problems associated with campus parking. Some of the earliest research concerning campus parking issues was conducted by Bennett (1956, 1958), who details how several university campuses in the United States have attempted to alleviate excess demand for parking. Eikenberry, Maher, Grant, and Kim (2015) and Scruggs, Epperson, Blevins, Mudd, and Franklin (2009) outline numerous issues that arise from the reduction in parking availability on university campuses. They propose several solutions to reduce parking demand on campus through comprehensive transportation demand management (TDM) options, including carpooling, alternative forms of transportation

(e.g., bicycling), and enacting mandates (e.g., restricting underclassmen from having a personal vehicle on campus).

Wang and Zhou (2010) evaluate the parking characteristics at Chang'an University in Xi'an, China. They also propose a variety of TDM measures that could be employed by the institution to control the demand for parking, including economic measures related to the spatial distribution of parking (i.e., proximal versus peripheral) on campus. Similarly, Shang, Lin, and Huang (2007) present a case study of the campus parking issues taking place at Beijing University of Aeronautics and Astronautics. They analyze survey data concerning parking behaviors (e.g., campus inflow and outflow, demand on lots, parking demand over time, parking duration), concluding, based on their analysis, that the "campus clearly lacks [a sufficient number of] parking berths."

Using survey data, Barata et al. (2011) assessed commuter satisfaction and willingness to pay for campus parking at the University of Coimbra in Portugal. Policy changes are suggested in their study, partially based on their willingness to pay results. A study to assess the mode of transportation that faculty at the Ayazaga Campus of Istanbul Technical University choose based on faculty rank was conducted by Tezcan and Taniş (2011). They found that age and income were the most highly correlated variables in predicting transportation mode, and they suggested policy changes that could be employed to encourage employees using private vehicles to switch to public modes of transportation.

Similar results regarding income level were found by Harmatuck (2007) using data collected at the University of Wisconsin-Madison campus. Harmatuck, however, also examines parking choice based on the monetary value that a permit holder places on walking time between their parking location and the building where they work, finding that the value of this walking time ranged from $4 to $30 per hour. Sultana (2015) also found that students' choice to purchase a parking permit at the University of North Carolina at Greensboro significantly increased with age and income.

Narragon et al. (1974) developed a probabilistic model to evaluate various policies related to the over-issuance of permits given a limited number of campus parking spaces. Batabyal and Nijkamp (2007) contribute to the literature stream by estimating a probability density function of the number of parking violators at given parking lot inspection times. Armed with this information, they argue that a PMU can maximize revenue obtained from ticketing parking violators by optimizing the time in which they inspect lots. Schmidt and Westley (2010) suggest that universities, which purportedly profit from parking violators via the issuance of tickets resulting in fines, have a long run interest in not deterring parking violations. They contend, however, that this ultimately results in reduced parking availability for individuals that purchase legitimate parking permits.

Shaheen and Khisty (1990) present a case study that outlines the action plan taken at Washington State University to minimize the resistance to parking fee increases at the institution. Interestingly, Shaheen and Khisty appear to approach the parking issue solely from the perspective that too few parking spaces exist on campus rather than an issue concerning the availability of parking spaces. Consequently, their article focuses on how increased parking permit fees would allow for the construction of additional parking spaces (i.e., increased supply) on campus. As Kelly (2016) suggests, increasing parking space supply can lead to economic inefficiency (i.e., subsidy) by not capturing the full value of preferred parking spaces currently available.

Considerable research regarding university parking has focused squarely on the fact that parking is underpriced and therefore oversold, resulting in parking demand far exceeding available

supply (e.g., Anderson, 1996; Batabyal & Nijkamp, 2007; Narragon et al., 1974). These researchers generally argue that underpriced campus parking directly leads to time spent "hunting" for parking (a hidden cost), illegal parking behaviors, false information being provided to secure a certain permit type, increased traffic congestion, decreased transportation-related safety, and permit holder frustration, inconvenience, and dissatisfaction (Anonymous, 2004; Bridgelall, 2014; Burr, 2011; Chance, 2006; Guo, Huang, & Sadek, 2013; Schmidt & Westley, 2010; Shaheen & Khisty, 1990; van der Waerden, et al. 2006). For instance, Shoup (1997, 2005a, 2005b, 2008), in a series of publications, provides a comprehensive assessment of parking issues faced by many university campuses in the United States, essentially reducing these issues to one root cause; namely, the inappropriate pricing of campus parking permits. Shoup presents a persuasive argument showing that when universities price campus parking below market rates in order to mollify various user groups (i.e., provide a subsidy), then the concomitant outcome is inflated demand for parking that far exceeds the available supply of parking spaces.

Some researchers have directly evaluated the impact of price on demand for campus parking through empirical research. Heath (2005), for example, presented a simulated campus parking game that demonstrates the effect that price discrimination has on increasing parking efficiency. The simulation revealed that, theoretically, price discrimination can reduce search costs and opportunity costs, while simultaneously and counterintuitively increasing consumer surplus.

Gadsby et al. (2003) evaluated the willingness of purchasers of George Mason University parking permits to participate in an online auction to bid for the right to park in specific lots. They conducted a simulated auction using campus permit buyers as participants and found that net permit revenue would increase by approximately $2 million over the university's present system of permit pricing (zone-based pricing). Pretty (1994) calculated the elasticity of demand for campus parking at an Australian university after the introduction of parking fees, finding that students were less price sensitive than university staff.

In a recent study, Tezcan (2012) assessed the use of price as a tool to adjust the travel demand at the Ayazaga Campus of Istanbul Technical University. He found that if a fee, rather than free parking, was placed upon campus parking, then a significant number of individuals driving private vehicles to campus would switch their mode of transportation to mass transit. van der Warden et al. (2006) found a similar effect for charging a fee for parking at the Eindhoven University of Technology, which had otherwise been free.

STUDY OBJECTIVES

While preceding literature has added significantly to the understanding of the parking dilemma at university campuses, very little research has been conducted to understand the demand for campus parking from a fundamental economic perspective. As previously mentioned, Shoup (1997, 2005a, 2005b, 2008) advances the idea that market prices ultimately dictate the availability of campus parking.

Similar to Tezcan (2012) and Shoup (2008), we subscribe to the position that price is likely to be the most powerful demand management tool that can be utilized by universities to better control and address their campus parking problems. In this study, we also recognize that universities are monopolists with respect to their parking assets (Schmidt & Westley, 2010), a fact that appears to be overlooked in the majority of the literature discussing university parking. In other words, the sole control of parking by an academic institution and the spatial location of parking lot assets on a university campus results in economic rent, which takes the form of a

monopolistic return similar to that experienced by municipalities that own parking assets (e.g., Ross 1958). From an economic perspective, however, the challenge of a monopoly is the provision of a product that, from their consumers' perspective, is of adequate quality and priced fairly.

Our objective is to assess the substitutability between different campus parking permit types offered by a PMU based on proximity and market price. Additionally, we extend the current field of research by going beyond a simulation (e.g., Zhao, Li, Wang, Li, & Du, 2018) to consider demand effects at various price levels. This research provides a first glimpse into the price dynamics of parking on a university campus using survey data. In addition, similar to Gadsby et al. (2003), we assess the demand for campus parking using an auction model, but add a twist in that we also incorporate the availability of reserved parking spaces in our auction analysis.

The primary objectives of this study, using a specific university as a case example, are enumerated as follows:

- *Estimate the demand function for each PMU parking permit type under an auction system.*
- *Determine the substitutability of PMU parking permit types through estimation of cross-price elasticity of demand.*
- *Investigate the nature of current PMU parking permit pricing with respect to market distortion (e.g., subsidies).*
- *Develop policy recommendations to ensure efficient means of allocating PMU parking supply such that it meets expected demand.*

CASE UNIVERSITY

This University of Idaho (UI), the State of Idaho's flagship institution of higher education, represents this study's case example. The UI is located in Moscow, Latah County, Idaho, and is situated approximately eight miles east of Washington State University (WSU), in Pullman, Whitman County, Washington. Both UI and WSU are land-grant universities, and demand for parking at both universities is partly affected by shared academic programs and the cross-listing of courses between the institutions.

The study was undertaken at the request of the PMU, with the explicit direction that the research explore the auctioning of parking. The PMU provided full cooperation in the execution of the study.

The UI's parking permit pricing system is largely based on parking lot proximity to high demand locations on campus, which is very similar to the university parking permit pricing schemes described by Shaheen and Khisty (1990) at WSU and Filipovitch and Boamah (2015) at Minnesota State University, Mankato. The majority of parking permits issued by the UI fall into one of five categories and are described by the UI's PMU as follows:

- *Gold Permit: Gold permits are available for purchase by board-appointed UI faculty and staff only and are priced at annual rate of $325. Parking spaces for gold permits are located at high demand locations. Gold permits are valid in all gold, red and blue parking lots on campus. Gold permits are not valid in silver or purple lots, meters, pay station lots, any specially marked space, or on the campus walkway system. About 13 percent of the PMU's gross revenue is generated from the sale of gold permits.*

- *Red Permit: Red permits are available for purchase by any UI faculty, staff, or student and are priced at annual rate of $172. Parking spaces for red permits are located between high demand locations and the periphery of campus. Red permits are not valid in gold, silver, or purple, meters, any specially marked space, or on the campus walkway system. About 32 percent of the PMU's gross revenue is generated from the sale of Red permits.*
- *Blue Permit: Blue permits are available for purchase by any UI faculty, staff, student, or frequent visitor and are priced at $64 for a one-year permit. Parking spaces for blue permits are located on the periphery of campus and tend to be in large lots. Blue permits are valid in all blue lots on campus. Blue permits are not valid in any other colored lot, meters, any specially marked space, or on the campus walkway system. About 12 percent of the PMU revenue is generated from the sale of blue permits, though 25 percent of parking spaces on campus are in blue lots.*
- *Purple Permit: Purple permits are available for purchase by current Greek members who reside in a campus-based sorority or fraternity house, as well as residents of two university-sponsored student living halls. Priced at $147, the permit is valid for one year. Purple permits can be used in all purple, silver, and blue lots on campus. Purple permits are not valid in gold or red lots, meters, any specially marked space, or on the campus walkway system.*
- *Silver Permit: Silver permits are available for purchase by current residents of UI Housing (i.e., dormitories) and are priced at $147 for a one-year permit. Silver permits are valid in all silver, purple, and blue lots on campus. Silver permits are not valid in gold or red lots, meters, any specially marked space, or on the campus walkway system.*

It should be noted that certain university administrators (president, provost, vice provosts, vice presidents, and college deans) are provided the option to purchase a parking space that is reserved 24 hours a day, seven days a week, and is located very near their respective offices.

Several other types of permits are issued by the university, (e.g., delivery vehicle, disability, media, retiree), but these represent a substantially smaller proportion of permits sold. Total gross revenue generated by parking permit sales and parking fines during the academic year of 2011-2012 was about $1.44 million.

The total number of current students, administrators, faculty, and staff on the UI campus is approximately 14,000, while the number of parking spaces the UI supplies on campus is 5,804. Thus, the ratio of the number of regular campus users to the number of campus parking spaces is about 2.4. Aggressive institutional efforts are underway to increase student enrollment at the UI campus by 50 percent over the next decade. If no new parking supply is added or parking restrictions implemented (e.g., ban freshman vehicles on campus) while the university proceeds with its growth plan, then the ratio of regular campus users to campus parking spaces will exceed 3, and likely increase negative parking related issues across campus.

METHODS

A web-based survey instrument was utilized to collect data for this study using the Tailored Design Method developed by Dillman, Smyth, and Christian (2008). The sample frame, provided by the university's PMU, consisted of all UI administrators, faculty, staff, and students that had

purchased a campus parking permit within the past year, yielding a total of 5,065 sampling units (820 Gold, 1,700 Red, 1,250 Blue, 525 Purple, 770 Silver). An email message describing the research was sent to all 5,065 sampling units, which also included a link to the web-based survey instrument. An incentive, representing a 25 percent off coupon for any university-branded merchandise sold at the UI Bookstore, was provided to increase the survey response and completion rates.

The survey instrument consisted of demographic, behavioral, and perceptual measures, as well as a conjoint component specifically designed to assess price sensitivity to different permit types currently offered by the PMU. The design of the conjoint study was put into the context of an auction market, including the auctioning of parking spaces exclusive to the purchaser (i.e., reserved parking).

In a conjoint study, attributes considered to have a substantial influence on consumers' preferences, and therefore their demand, are identified (Orme, 2006). Individuals are then asked to state their preference for combinations of different levels of a product's (service's) most relevant demand-inducing attributes. Ranking each individual's preferences for these different combinations of attribute levels allows one to estimate, or decompose, what share of the total utility is gained from specific attributes of a purchased or consumed product (Hair, Black, Babin, & Anderson, 2010). Furthermore, conjoint analysis allows researchers to characterize the relative importance to consumers of each attribute; the amount each attribute contributes to total utility of a product for an individual can be represented as a percentage share, and these shares can then be averaged to compute the attribute importance for a group (e.g., market segment) as a whole. An extensive body of literature exists that describes conjoint analysis method and its application (e.g., Green & Srinivasan, 1990; Gustafsson, Hair et al., 2010; Herrmann, & Huber, 2010; Orme, 2006).

A total of four separate conjoint surveys were conducted in the study, but each study participant completed only one survey; the conjoint survey that a study participant completed was based on the parking permit type that they had purchased within the past year (gold, red, blue, or silver). Thus, if a study participant had purchased a gold parking permit within the past year, then the conditional logic of the web-based survey would have the individual complete the gold permit survey. With the exception of the conjoint portion of the survey instruments, all other questions across the four separate surveys were identical and presented in the same order.

All four conjoint surveys were based on a part-worth linear preference model (cf. Hair et al., 2010), using a full concept orthogonal design (IBM Corporation, 2012). The model consisted of the following two attributes: permit category and permit price. It is important to make the distinction of permit types and permit category. Permit type, as previously discussed, represents the color of the parking permit, which provides a designation for which lots a purchaser can park. The permit category represents whether the permit is a standard parking permit or a reserved parking permit. Permit types and categories included gold, reserved gold, red, reserved red, blue, reserved blue, silver, and reserved silver. The survey specifically stated that a reserved parking permit would "provide you an exclusive parking space in a particular [insert permit color type] lot." Thus, a reserved gold parking permit would dedicate to the purchaser a parking space in a specific gold lot, but would also allow the purchaser to park in any other gold, red, or blue lot. Similarly, a reserved blue permit would dedicate to the purchaser an exclusive parking space in a particular blue lot, while at the same time allowing parking in any other gold, red, or blue. The following parking permit prices were used in the conjoint portion of the study: $300, $350, $400, $450, $500, $750, $1,000, $1,250. Output generated from the conjoint analyses included utility

estimates for the price levels and the permit categories (i.e., reserved and standard for each permit type), as well as importance scores for the variables price and permit category.

RESULTS AND DISCUSSION

A total of eight email surveys were undeliverable, resulting in a total effective sample size of 5,057. The number of fully completed surveys was 1,182, yielding an effective response rate of 23.4 percent. An additional 41 survey were fully completed, but the participant failed to indicate which type of permit they had most recently purchased, which was a requirement for inclusion in the conjoint analyses. The number of responses and associated response rate by permit type are shown in Table 1. Interestingly, with the exception of silver permit purchasers, the survey response rate increased with the increase in the price of the permit most recently purchased from the UI. For instance, the response rate for gold permit purchasers was more than 150 percent greater than that of purchasers of a purple permit.

Table 1
SUMMARY OF SURVEY RESPONSE BY MOST RECENT PERMIT TYPE PURCHASED

Permit Type	Sample Size	Number of Responses	Response Rate (%)
Gold	820	295	36.0
Red	1,700	395	23.2
Blue	1,250	265	21.2
Purple	525	75	14.3
Silver	762	152	19.9
Total	5,057	1,182	23.4

From a demographic perspective females respondents outnumbered males, representing 58 percent of the study participants. Study participants' ages ranged from 19 to 83 years, with a mean of 33.2 years and a median 28 years. The majority of study participants were single (53.1 percent), while 42.2 percent were married, and 4.2 percent were divorced and not remarried. Unemployed individuals represented 23.1 of the study participants, while 22.9 were part-time employed, and 43.6 percent were employed full time. Just over 10 percent of the respondents did not indicate their employment status. Students represented 48.4 percent of the study participants, followed by staff (32.2 percent), faculty (10.4 percent), and 9.0 percent failing to indicate an affiliation with the institution. Of the 592 students responding to the survey, 19 percent were freshman, 20 percent sophomore, 20 percent junior, 18 percent senior, 6 percent fifth year undergraduate, and 7 percent graduate student.

Both the average and median gross income reported by study participants fell within the range of $20,000 and $24,999. The median gross income reported by students was in the range of $0 to $4,999, while staff reported a median gross income in the range of $40,000 to $44,999. Faculty reported a median gross income in the range of $75,000 to $79,999.

A series of questions were asked of survey participants to understand their current disposition toward and use of the current UI parking permit system. More than 90 percent of respondents indicated that they were able to purchase their desired parking permit type, though the mean probability that a respondent would purchase the same permit type as their most recent purchase was 75 percent. This suggests that there may be latent demand for parking permits that provide access to premium lots (e.g., gold permits). Alternatively, purchasers may be considering

"buying down" their choice of permit, finding the value of the benefits obtained from the purchase of premium permits being less than expected.

Individuals purchasing purple and silver permits reported an average distance of travel to campus as 0.15 miles. In other words, these individuals either lived on campus (e.g., dormitory), an apartment adjacent to campus, or in Greek housing. Individuals purchasing blue parking permits travel an average distance of 2.0 miles to campus from their home, while those purchasing red parking permits travel an average distance of 1.9 miles. Purchasers of gold parking permits were found to travel an average distance of 6.1 miles to arrive on campus from their place of residence.

Study participants were asked how often they found a parking space in the lot associated with their parking permit. Results, displayed in Table 2, indicate that more than 70 percent of gold and blue parking permit holders either always or almost always can find a parking space in their permitted lots. Individuals purchasing red, purple, and silver parking permits were much less likely to find a parking space in their permitted lots. Approximately one-third of all purple parking permits holders indicating that they either never or sometimes found a parking space in their permitted area. These results strongly suggest demand for red, purple, and silver parking spaces exceeds the available supply.

Table 2
ABILITY OF SURVEY PARTICIPANTS TO FIND A PARKING SPACE IN THE LOT ASSOCIATED WITH THEIR PERMIT TYPE

	I usually find a parking space in the lot I have a permit for. (percent of responses)					Total Number of Responses
Permit Type Purchased	Never	Sometimes	Most of the Time	Almost Always	Always	
Gold	0.4	9.3	19.7	32.6	38.0	279
Red	1.6	21.3	32.3	29.1	15.7	362
Blue	0.0	6.2	16.8	33.2	43.8	256
Purple	2.8	29.3	31.9	22.2	13.8	72
Silver	0.7	21.8	26.8	29.6	21.1	142
All Types	0.9	15.4	24.8	30.5	28.4	1,111

Conjoint analyses were conducted for each parking permit type except purple, for a total of four analyses; data from purchasers of purple parking permits was excluded from analysis due to the relatively low number of responses from this group. The significance values for Pearson's R, a measure of conjoint model fit, for the gold, red, and blue parking permit analyses were quite high, being 0.034, 0.000, and 0.041, respectively. The Pearson's R significance value for silver parking permit conjoint analysis was 0.186, suggesting unstable estimates. This instability may be a function of a low response rate by purchasers of silver permits and/or a high level of variability in their responses to the conjoint-related questions in the survey.

Table 3 presents the importance scores for the attributes of permit price and permit category generated for each parking permit type. Results of the gold, red, and silver parking permit conjoint analyses indicate that permit price carried significantly more weight on calculated attribute level utilities than permit category. Results of the blue parking permit conjoint analysis, however, indicated that permit category had substantially more weight on calculated attribute level utilities. This result suggests that blue permit holders are less sensitive to permit price as it relates to whether the permit category is reserved or standard.

Table 3
ATTRIBUTE IMPORTANCE VALUES ASSOCIATED WITH PERMIT AND PRICE CATEGORY BY PARKING PERMIT TYPE

	Importance Value	
Permit Type	Permit Price	Permit Category
Gold	68.91	31.09
Red	81.64	18.36
Blue	26.78	73.22
Silver	85.76	14.24

After obtaining the initial conjoint results, the information was used to conduct simulations in order to estimate the price elasticity of demand for each of the four permit types; price elasticity of demand information allows for inspection of the impact of price changes on the resulting demand for parking permits. Note that price elasticity of demand, as defined by economists, is specified as the percentage change in quantity demanded divided by the percentage change in price. With the use of conjoint analysis, however, demand share is used to estimate price elasticity of demand rather than quantity demanded. In other words, the changes in consumers' choice of one product relative to another (i.e., trade-off) are reflected in changes in price, where the total sum of share across products is 100 percent (cf. Orme, 2006). The interpretation of estimates of price elasticity of demand using either quantity demanded or demand share are the same; namely, measured in absolute value, estimates less than 1.0 are considered inelastic, estimates greater than 1.0 are considered elastic, while estimates of 1.0 are unitary elastic.

In this study, gold parking permits ranged in price from $300 to $1,250. Using the conjoint results, we simulated the price elasticity of demand for standard gold parking permits (i.e., an unreserved parking permit) by removing the reserved permits and only allowing price to change (Orme, 2006). Similar simulations were conducted for standard red, blue, and silver parking permits. Red and blue parking permits ranged in price from $60 to $500, while silver parking permit prices ranged from $125 to $500.

The price elasticity of demand estimate for standard gold parking permits was found to be 0.32, indicating a relatively inelastic demand curve. The price elasticity of demand estimates for standard red and blue parking permits were also found to be slightly inelastic, being 0.97 and 0.92, respectively. The price elasticity of demand estimate for standard silver parking permits was found to be extremely elastic, at 7.65, indicating that purchasers of this type of permit are very price sensitive. Given that silver parking permits are only available to students who are residents in university-owned housing, it is not particularly surprising that these buyers are highly sensitive to changes in permit prices. These individuals tend to be very income constrained, while at the same time expending a considerable sum of money to pay for their education.

Next, we assessed the premium that study participants would pay for a reserved parking permit for each of the four parking permit types. This premium was calculated using a multistep process, beginning with the calculation of the difference between the estimated utilities for the price variable and dividing by the full range of price used in the study. This value was then divided into the difference in estimated utilities for the permit category attribute (i.e., the difference between standard and reserved parking permits), and then subtracted from the current market price for each permit type. Those individuals completing the conjoint analysis for gold parking permit purchasers were found to be willing to pay, on average, a premium of $377.70 for a reserved gold parking permit. Thus, a premium gold parking permit under this scenario would cost the buyer $702.70 (i.e., base permit price plus premium) on an annual basis. Recall that a reserved gold

parking permit allows one to park in a specific reserved space in a gold parking lot, while also allowing parking in all other lots. Obtaining a reserved gold parking permit eliminates the need to search for a parking space in a gold parking lot. Thus, the $377.70 premium may reflect a portion of the annualized search cost ("hunting" cost) of finding a parking space in gold lots.

Red parking permit purchasers were found to be willing to pay a premium of $84.91 for a reserved space in a red parking lot, which would also allow the purchaser to park in other available lots on campus except gold lots. Blue parking permit purchasers were willing to pay $219.63 for a reserved space in a blue parking lot. Interestingly, if one adds the premium prices for red and blue reserved parking permits to their standard permit equivalents, then the resulting prices for each are well below the current standard gold permit price ($68.09 less for red permits and $41.37 less for blue permits). The discount for blue reserved parking permits relative to standard gold parking permits is somewhat surprising given the importance blue permit purchasers placed on permit category; in other words, our results strongly suggest that blue permits are significantly underpriced by the institution.

The premium associated with a reserved blue permit could possibly be attributed to a prestige value that a purchaser of such a permit may ascribe to a reserved parking permit. If this is indeed true, then it suggests that a conversion of a certain proportion of blue parking capacity to a higher priced reserved status would substantially increase revenue obtained from these lots.

Silver parking permit purchasers were found to be willing to pay a premium of $154.37 for a reserved space in a silver parking lot, while being able to park in any other campus parking lot. This represented a $34.63 discount relative to a standard gold parking permit.

Given the results, if the PMU at the UI were to reserve 10 percent of spaces in gold, red, blue, and silver lots, and price these reserve spaces at the average premiums aforementioned, then gross revenue would increase by nearly $89,000 per year. Similarly, reserving 50 percent of spaces in these same lots would generate additional gross revenue of $444,000 per year.

CONCLUSION

In this case study, the price premiums that participants indicated that they would be willing to pay to obtain reserved parking spaces reflect an underpricing of parking permits. It is worth noting that study participants were not allowed to "trade up" from their current permit type (e.g., from red to gold). Thus, the calculated gross revenue gains from increasing permit prices across all permit types may be underestimated in our results.

The PMU at the UI is likely substantially underpricing gold, red, blue, and silver permits given the magnitude of the premiums individuals indicated that they are willing to pay for reserved parking; this is especially true for blue permits.

According to the PMU at the UI, the total revenue from permit sales and parking fines at the time this study took place was $1.44 million. Reserving 10 percent of gold, red, blue, and silver parking spaces would therefore increase gross revenue by $89,000 (6 percent increase), and reserving 50 percent of parking spaces would generate additional gross revenue of $444,000 (30 percent increase). From the consumers' perspective, a significant percentage increase in the price of parking permits would likely lead to a high degree of outrage on campus, as would the reservation of a large number of parking lot spaces. For instance, in conversations with our colleagues in the College of Business and Economics, we heard repeatedly from individuals with advanced training in economics that the institution had a moral obligation to provide nearby and "fairly priced" parking for administrative staff. Yet, few (if any) large corporations with

constrained parking options feel any responsibility to provide parking (or a subsidy) for their administrative staff, nor do administrative staff seem to believe that they should. Indeed, a benefit that many administrative staff obtain by the requirement that they arrive early to work is that they have access to preferred parking on a consistent basis.

While our study was undertaken at the request of our PMU, once provided with the results there was not only no change in university parking polices, there was little comment or feedback. Our interpretation is that the administration "blinked" when considering the nonmonetary costs of providing higher priced reserve permits. In other words, in their view, the potential cost of ill will among members of the university community exceeded the rather significant increase in gross revenue. That this occurred in the midst of very tight budgets, increasing student tuition, stagnant wages for faculty and staff, reduced faculty positions, and larger classroom sizes makes the inaction of the administration all the more significant.

Rather than segment its parking permit market based on consumer price sensitivity and extract greater revenue on a target that is willing to pay more for a service, the university instead chose to increase across the board tuition and fees and restrict wage and salaries as well. Furthermore, maximizing revenue from those that would pay more would lessen the need for increases of basic permit prices (i.e., non-reserved spaces). In other words, the university could be employing a reserved-based parking permit system that would significantly reduce price inflation of non-reserved permits and still substantially increase gross revenue.

Finally, by having access to what our study clearly shows is below market value 24/7 reserved permits, administrators have little personal interest in changing parking policies that would have no direct impact on them. It is also worth noting that the PMU is located adjacent to the largest blue lot on campus. Ironically, the head of PMU, as well as the entire PMU staff, has access to consistently available parking at the lowest cost on campus.

Arguably, parking is a complex good with layers of meaning beyond a simple space for those of the campus community to use. For professors, the status of parking permits goes almost hand-in-hand with their degrees and titles, starting with their student permits and working up to the faculty permit that goes with their doctorate degree. Indeed, the traditional conferring of a Ph.D. includes the language "with all the rights and privileges pertaining thereto." This could readily be modified to "including the right to buy a faculty parking permit." Moreover, faculty members experience the constant status reminder of their position relative to the administration when searching for parking space when passing 24/7 reserved administrator spaces (i.e., premium spaces) that are very often not being used.

Students might argue that the university exists primarily to educate them but feel that parking policies treat them as the most inferior of customers. The UI campus is rather compact, and to walk from one extreme corner of campus to the other requires less than fifteen minutes. In our estimation, the farthest anyone would need to walk from a blue lot to their office would take no more than ten minutes. Numerous individuals that purchase a gold permit also pay for access to the university's workout facilities or spend their lunch hour engaged in strenuous physical exertion that far exceeds any effort they would expend walking to their office from a blue lot. Thus, the belief that parking is a public good seems somewhat irrational and puzzling. The institution's pricing strategies, however, do not need to be irrational in turn. Rather, PMU pricing strategies should capitalize on this irrationality among consumers.

As a monopolist, PMUs are likely to provide inadequate parking spaces and charge a higher price than would be expected under competition. However, most PMUs should be viewed as regulated monopolists that are required only to cover their variable costs. University administrators

are motivated to leave PMU units alone if variable costs are being met rather than create a controversy in an area viewed as non-central to the institution's core mission. The UI PMU is a self-sustaining unit. While this means that the university does not directly subsidize parking, it does remove from the PMU the incentive to pursue innovative solutions to better meet parking demands and improve constituents' satisfaction with their parking choices. For instance, we suggested that a business plan be developed to assess the financial feasibility of a parking garage facility. The offer was rejected on the basis that adequate parking was being provided to meet the *needs* of the university. Ignored was that parking *wants* are certainly not being met, as demonstrated by the premium that some are willing to pay for reserved parking, and that any enrollment growth will certainly create more stress on parking.

Against the perception of campus parking as a public good is the growing realization of the environmental costs associated with parking. Not only are capital costs associated with parking high, parking facilities encourage driving to campus rather than carpooling, walking, or biking. In addition, parking facilities generate storm runoff and increase contaminant loading (e.g., oil, grease, fuel, heavy metals, solid waste) into freshwater systems (e.g., Davis, Pijanowski, Robinson, & Engel, 2010; Jakle & Sculle, 2005). Lastly, new parking facilities often consume green space. Therefore, it is possible that as the environmental costs of parking are more widely recognized on campus that it will be perceived less as a public good and more as an environmental cost; this, in turn, will impact the policies of the PMU.

LIMITATIONS

Although multiple pretests of each of the four conjoint surveys was conducted to assess, in part, whether the range of prices used in the study were considered reasonable, there is a possibility that the range exceeded the expectations of a number of study participants. Study participants may have anchored the first price presented in the study, which may have been perceived as unreasonable, and adjusted their future evaluations based on this price (Epley & Gilovich, 2001). Thus, prices exceeding the range of what one would expect may have led some study participants to express excessive price premium estimates, thereby increasing the price elasticity of demand.

In addition, in order to make the study more tractable, study participants were limited to evaluating a pricing situation for the permit that they had most recently purchased. For instance, red permit holders were guided to complete a conjoint survey focused on red permits. This limitation may have led to overestimated price premiums for reserved gold and red permits, as purchasers of gold and red permits have much greater flexibility in "buying down" to the next permit type (i.e., gold to red; red to blue) relative to the other permits. Future research, using conjoint analysis, could evaluate substitutability across permit types.

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REFERENCES

Anderson, B. (2006). The parking puzzle. *Stanford Magazine, 24,* 82-85.
Anderson, S. P., & de Palma, A. 2004. The economics of pricing parking. *Journal of Urban Economics, 55,* 1-20.
Anonymous. (1958). Education: View from the bridge. *Time, 72,* 96.
Anonymous. (2004). Parking in higher education – The pros speak out. *Parking Today, 9,* 12-14, 44.
Arnott, R, & Rowse, J. (1999). Modeling parking. *Journal of Urban Economics, 45,* 97-124.
Barata, E., Cruz, L., & Ferreira, J. 2011. Parking at the UC Campus: Problems and solutions. *Cities, 28,* 406-413.

Batabyal, A. A., & Nijkamp, P. (2010). A probabilistic analysis of two university parking issues. *The Annals of Regional Science, 44,* 111-120.

Bennett, W. (1956). University campus parking. *Traffic Quarterly, 10,* 89-105.

Bennett, W. (1958). The car and college campus. *Traffic Quarterly, 12,* 602-610.

Bridgelall, R. (2014). Campus parking supply impacts on transportation mode choice. *Transportation Planning and Technology, 37,* 711-737.

Burr, D. W. (2011). Is university parking a common grievance? *Parking Today, 16,* 32-33.

Campus Parking Management Associates. (1999). *The complete campus parking manual: A comprehensive resource guide for campus parking administrators, supervisors and managers*. Goshen, Kentucky: Campus Parking Management Associates.

Chance, B. (2006). Higher ed parking funded by outdated procedures. *Parking Today, 11,* 35.

Davis, A. Y., Pijanowski, B. C., Robinson, K., & Engel, B. (2010). The environmental and economic costs of sprawling parking lots in the United States. *Land Use Policy, 27,* 255-261.

Dillman, D. A., Smyth, J. D., & Christian, L. M. (2008). *Internet, mail, and mixed-mode surveys: The tailored design method*. Hoboken, New Jersey: John Wiley and Sons, Inc.

Ehrenberg, R. G. 2000. *Tuition rising: Why college costs so much*. Cambridge, Massachusetts: Harvard University Press.

Eikenberry, A., Maher, C., Grant, F., & Kim, J. (2015). *Enhancing transportation demand management options at the University of Nebraska at Omaha: The costs, benefits and challenges of implementation*. Omaha, Nebraska: University of Nebraska at Omaha Center for Urban Sustainability.

Epley, N., & Gilovich, T. (2001). Putting adjustment back into the anchoring and adjustment heuristic: Differential processing of self-generated and experimenter-provided anchors. *Psychological Science, 12,* 391-396.

Epstein, R. A. (2002). The allocation of the commons: Parking on public roads. *The Journal of Legal Studies, 31,* S515-S544.

Farrell, S., Mahony, M., & Caulfield, B. (2005). Attitudes and behavioral responses to measures to deal with workplace parking. *Transportation Research Record, No. 1932,* 178-187.

Filipovitch, A., & Frimpong, E. F. (2015). A systems model for achieving optimum parking efficiency on campus: The case of Minnesota State University. *Transportation Policy, 45,* 86-98.

Forman, J. C. (1971). *Parking on college and university campuses: An annotated bibliography*. Albany, New York: New York State Education Department, Bureau of Occupational Education Research.

Gadsby, E., Jaimes, S., Najarian, L., Sanchez, M., Sujlana, R., Donohue, G. L., & Coyne, M. (2003). George Mason University (GMU) Fairfax Campus Transportation System. In M. H. Jones, B. E. Tawney, and K. P. White (Eds.) *Proceedings of the 2003 Systems and Information Engineering Design Symposium (pp. 77-82).* Charlottesville, Virginia: Institute of Electrical & Electronics Engineers.

Green, P. E., & Srinivasan, V. (1990). Conjoint analysis in marketing: New developments with implications for research and practice. *Journal of Marketing, 54,* 3-19.

Grubb, M. D., & Oyer, P. (2008). *Who benefits from tax-advantaged employee benefits? Evidence from university parking*. NBER Working Paper No. 14062. Cambridge, Massachusetts: National Bureau of Economic Research.

Guo, L., Huang, S., & Sadek, A. W. (2013). A novel agent-based transportation model of a university campus with application to quantifying the environmental cost of parking search. *Transportation Research Part A, 50,* 86-104.

Gustafsson, A., Herrmann, A., & Huber, F. (2007). *Conjoint measurement: Methods and applications*. New York, New York: Springer.

Hair, J. F., Black, W. C., Babin, B. J., & Anderson, R. E. (2010). *Multivariate data analysis*. Upper Saddle River, New Jersey: Pearson Education.

Harmatuck, D. J. (2007). Revealed parking choices and the value of time. *Transportation Research Record, 2010,* 26-34.

IBM Corporation. (2012). *IBM SPPS Conjoint 21*. Armonk, New York: IBM Corporation.

Jackle, J. A., & Sculle, K. A. (2005). *Lots of parking: Land use in a car culture*. Charlottesville, Virginia: University of Virginia Press.

Jeppesen, J., & Dorsett, J. (2014). Colleges and universities are taking a fresh look at campus parking. *Planning for Higher Education, 42,* 33-36.

Kelly, G. T. (2016). *Bidding for parking: The impact of university affiliation on predicting bid values in Dutch auctions of on-campus permits*. Honors Thesis. Duke University, Durham, North Carolina.

Kelly, S. (2015). Parking problems. *The Argonaut, 116,* 10.

Kerr, C. (1966). *The uses of the university*. New York, New York: Harper and Row.

Litman, T. (2010). *Parking pricing implementation guidelines: How more efficient pricing can help solve problems, increase revenue and achieve other planning objectives*. Victoria, British Columbia, Canada: Victoria Transport Policy Institute.

Lyle, K. (2011). Parking changes could bring in $375 million for Ohio State. *The Lantern, 131,* 1A and 3A.

Meng, F., Du, Y., Li, Y. C., & Wong, S. C. (2018). Modeling heterogeneous parking choice behavior on university campuses. *Transportation Planning and Technology, 2,* 154-169.

Millard-Ball, A., Siegman, P., Tumlin, J. (2004). Solving campus parking shortages: New solutions for an old problem. *Planning for Higher Education, 33,* 30-43.

Mooney, C. J. (1993). Cultured murmur of academe threatens to be lost in the roar over parking: From shouting matches to fisticuffs, furious battles rage over a jealously guarded perk. *The Chronicle of Higher Education, 39,* A15-A16.

Munzir, S., Ikhsan, M., & Amin, Z. (2010). Linear programming for parking slot optimization: A case study at Jl. T. Panglima Polem Banda Aceh. In *Proceedings of the 6th Indonesia-Malaysia-Thailand Growth Triangle (IMT-GT) Conference on Mathematics, Statistics and its Applications (pp. 462-472)*. Kuala Lumpur, Malaysia: Universiti Tunku Abdul Rahman.

Narragon, E. A., Dessouky, M. I., & DeVor, R. E. (1974). A probabilistic model for analyzing campus parking policies. *Operations Research, 22,* 1025-1039.

Orme, B. K. (2006). *Getting started with conjoint analysis: Strategies for product design and pricing research*. Madison, Wisconsin: Research Publishers.

Pendakur, V. S. (1968). Access, parking and cost criteria for urban universities. *Traffic Quarterly, 22,* 359-387.

Pretty, R. L. (1994). The impact of parking policy measures on university commuters. *Transportation Planning and Technology, 18,* 155-162.

Ross, M. H. (1958). Product differentiation in the parking market. *Land Economics, 34,* 245-254.

Rye, T., Hunton, K., Ison, S., & Kocak, N. (2008). The role of market research and consultation in developing parking policy. *Transport Policy, 15,* 387-394.

Sandland, S. (2006). The practical problems faced by the University of East London in meeting the parking restraints within PPG13. *World Review of Science, Technology and Sustainable Development, 3,* 152-173.

Schmidt, B. H., & Westley, C. (2010). The university-as-monopolist: Why parking problems persist at university campuses. *Journal of Applied Business and Economics, 10,* 39-43.

Scruggs, M., Epperson, D., Blevins, J., Mudd, C., & Franklin, K. (2010). Addressing University of Kentucky parking: Opportunities for growth without construction. In *Gatton Student Research Publication*, 2. Lexington, Kentucky: University of Kentucky, Gatton College of Business and Economics.

Shaheen, J. A., & Khisty, C. J. (1990). Washington State University parking action plan – A campus parking case study. *Transportation Research Record, No. 1287,* 223-229.

Shang, H., Lin, W., & Huang, H. (2007). Empirical study of parking problem on university campus. *Journal of Transportation Systems Engineering and Information Technology, 7,* 135-140.

Shoup, D. (1997). The high cost of free parking. *Journal of Planning Education and Research, 17,* 3-20.

Shoup, D. (2005a). Parking on a smart campus: Lessons for universities and cities. In *California Policy Options (pp. 117-149).* Los Angeles, California: Ralph and Goldy Lewis Center for Regional Policy Studies.

Shoup, D. (2005b). *The high cost of free parking*. Chicago, Illinois: Planners Press, American Planning Association.

Shoup, D. (2008). The politics and economics of parking on campus. In S. Ison and T. Rye (Eds.), *The implementation and effectiveness of transport demand measures: An international perspective (pp. 121-149).* Aldershot, United Kingdom: Ashgate Publishing.

Smith, M. S. (2014). Will online learning significantly impact university parking? *Parking, 53,* 22-24.

Stevens, M. (2007). Campus parking permit scandal leads to charges of race discrimination. *Parking, 46,* 7-10.

Sultana, S. (2015). Factors associated with students' parking-pass purchase decisions: Evidence from an American university. *Transport Policy, 44,* 65-75.

Tezcan, H. O., & Taniş, M. (2011). Does the academic rank matter? Study on the trip preferences of academicians from different ranks employed at Istanbul Technical University. *Journal of Urban Planning and Development, 137,* 272-280.

Tezcan, H. O. (2012). Using parking pricing as a travel demand management tool at a university campus: An example for Istanbul Technical University. *Transportation Letters: The International Journal of Transportation Research, 4,*181-192.

Troop, D. (2011a). Nobel? Sure. Parking space? Maybe. *Chronicle of Higher Education, 58,* A1 and A10.

Troop, D. (2011b). Taming the parking beast: The options for colleges. *Chronicle of Higher Education, 58,* A10.

Tudela-Rivadeneyra, A., Shirgaokar, M., Deakin, E., & Riggs, W. (2015). The cost versus price for parking spaces at major employment centers: Finding from UC Berkeley. In *TRB 94th Annual Meeting Compendium of Papers*. Washington, DC: Transportation Research Board of National Academies.

van der Waerden, P., Borgers, A., & Timmermans, H. (2006). Attitudes and behavioral responses to parking measures. *European Journal of Transport and Infrastructure Research, 6*, 301-312.

Wang, Z., & Zhou, W. (2010). Current situation and improvement strategy for campus parking in China. In L. O'Conner (Ed.), *International Conference on Intelligent Computation Technology and Automation, Volume 1* (pp. 1075-1078). Los Alamitos, California: IEEE Computer Society.

Zhao, C., Li, S., Wang, W., Li, X., & Du, Y. (2018) Advanced parking space management strategy design: An agent-based simulation optimization approach. *Transportation Research Record*, 1-10.