Transport Policy 45 (2016) 86–98

Contents lists available at ScienceDirect

Transport Policy

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

A systems model for achieving optimum parking efficiency on campus: The case of Minnesota State University

Anthony Filipovitch [a,*], Emmanuel Frimpong Boamah [b]

[a] Urban and Regional Studies Institute, Minnesota State University, Mankato MN, USA
[b] Department of Urban and Public Affairs, University of Louisville, Kentucky, USA

ARTICLE INFO

Article history:
Received 15 April 2013
Received in revised form
6 May 2015
Accepted 22 September 2015

Keywords:
Parking demand and supply
Cost and benefits
Optimum parking prices
Optimal parking balance

ABSTRACT

An economic model of parking behavior was designed to consider the relationship between costs and benefits in meeting parking demands of the range of users on an urban university campus. Using Minnesota State University, Mankato campus as the case area, model simulations were run to answer the question, "How do we price parking permits to minimize parking supply surpluses/shortages on campus and still meet the cost of parking?" The study's results indicate that there is an over/undersupply of parking spaces when parking demand is determined only by the expected permit purchases without considering the peak use of parking facilities. This leads to the issues of excess parking costs and parking shortages which characterize the iterative process in campus parking pricing and supply policies. By running the model through several simulations, an "optimum parking price level" – that which minimizes supply excesses/shortages while also ensuring that revenue generated meets at least the annual operations and maintenance costs – was determined for each parking permit on campus.

1. Introduction

In many cities, universities with their staff and their student populations account for a significant proportion of the urban population. The provision of transport infrastructure, of which parking facilities form an important component, has been a major responsibility for the university authorities. University campuses present a particular problem since they combine pedestrian and vehicular travel modes, and conflicts are frequent, yet the standard texts on campus planning (see Dober (1996)) are silent on the topic. Parking is seen by Shoup (2005) as "Planning without Theory." In his book on "High Cost of Free Parking", Shoup discusses how texts in regional science, transportation planning and urban economics ignore parking.

As important as parking is in transportation and other infrastructure designs, limited resources (of money and of space) have restricted the ability of campuses to provide these parking facilities, hence the introduction of parking pricing measures. Such measures however require the determination of a price level to balance demand and supply (Shoup, 2008; Litman, 2011) as well as associated costs and benefits.

Existing vehicle parking research deals not only with charging for the use of these parking spaces to generate enough funds, but also the "how" involved in determining the "right" amount. In his article on "The Politics and Economics of Parking on Campus," Shoup makes the case that "faulty pricing" has become the problem with the parking pricing systems implemented by University authorities.

The challenges of parking are exacerbated as campuses and cities in general determine parking supply by using parking requirements (Tumlin, 2012; Shoup, 1999, 2005; Shoup and Pickrell, 1978) without paying much attention to how much it will cost (direct and indirect) now and in the future as we build and convert available lands to meet these parking requirements.

Since we cannot continue to convert all our available land to meet the seemingly insatiable parking needs of a population dependent on private vehicles, there needs to be a way out. This is especially important as parking budgets on campuses often involve very large sums of money. But we can still meet our parking demand without necessarily increasing the economic and socio-environmental cost on campuses. By developing an economic model and simulating results to predict future parking demand scenarios for one campus, this study explores which parking price levels achieve a balance between demand and supply without distorting the balance between cost and benefits.

2. Current parking situation at MSU, Mankato campus

2.1. Transportation mode share on campus

Minnesota State University is about a mile from the city center of Mankato, a city of about 18 square miles, and approximately

* Corresponding author.
E-mail addresses: anthony.filipovitch@mnsu.edu (A. Filipovitch), emmanuel.frimpongboamah@louisville.edu (E. Frimpong Boamah).

http://dx.doi.org/10.1016/j.tranpol.2015.09.010
0967-070X/

Table 1
Parking permit purchases by MSU students, faculty and staff.

Academic years	Resident students		Non-resident students		Faculty/staff	
	Total number	No. purchasing permits	Total number	No. purchasing permits	Total number	No. purchasing permits
2011/2012	3296	2134	10,602	2968	1464	1306
2010/2011	3233	2371	10,693	3429	1525	1408
2009/2010	3082	2266	10,777	3350	1580	1475
2008/2009	3073	2207	10,666	3221	1632	1437

85 mile (about an hour and half-drive) southwest of the Twin Cities of Minneapolis and St. Paul. Most of the off-campus student housing is scattered less than half a mile around the campus. The city of Mankato has a joint partnership with the University to provides bus service to students in the immediate campus area (rather than requiring the purchase of citywide bus permits). Some parking permit groups were also given the opportunity to ride the bus for free after parking at lots located between 10 and 15 min walk from most of the classrooms.

Using the number of permit purchases as a proxy in measuring the approximate number of vehicle ownership on campus from 2008 to 2012, as shown in Table 1, an average of 70%, 30% and 90% of resident students, non-resident students and faculty/staff respectively drive on campus. This number does not capture those who use the free parking lots (about 450 vehicles at peak time) or visitors' lots (about 140 vehicles at peak time). The relatively short travel time to Mankato from the Twin Cities and other surrounding communities encourages faculty and staff to commute to campus. Most resident students work off-campus at nights and on weekends. Others also travel home almost every weekend. In light of these commuting needs, the limited citywide bus services at night and on weekends encourage high vehicle ownership among the resident students. Having most of the off-campus housing close to campus with free parking lots often provided, it often makes sense for non-resident students to park their vehicles to use the bus or ride with their friends to campus. Vehicle ridership on campus is popular among the non-resident full/part-time students who live and/work close to the Twin Cities area.

2.2. MSU's surface parking situation

A parking occupancy survey conducted over a three day period for this study (Fig. 1) showed that occupancy levels for the various parking permit groups range from 50% to 82% within a 9 h period within a school day. At an 85% occupancy level, an average maximum of 45% (1326) and average minimum of 10% (121) of parking spaces (based on the total number of surveyed parking spaces) are empty[1] within a 9 h school period (8 a.m. to 5 p.m.). Even at the peak period, the vacancy rate is as high as 18% of the total parking supply surveyed, yet people find it difficult to find parking spaces. Aside from the direct cost (capital and maintenance) that these empty spaces represent to MSU, there is also an opportunity cost incurred since each vacant space represents a land area that could have been used for something else.

Fig. 1 also shows that between the hours of 10 a.m. (peak time) to about 3 p.m., parking occupancy is relatively constant and exceeds 65% occupancy level. The average percent change in the decrease of occupancy is as low as 0.3% within this period. In a 2005 downtown parking study for the city of Spokane, the authors (a team of consulting firms, Melvin Mark Development Company and Nelson/Nygaard Consulting (2005)) asserted that parking occupancy is consistent with patterns of commuter parking typical of off-street use in urban areas when the use of parking facilities remains constant between the hours of 10:30 a.m. and 3:30 p.m., and exceeds 60% occupancy level (Fig. 2).

2.3. Characteristics and occupancy level of parking permit groups on campus

2.3.1. Gold permits

Almost all parking lots close to classrooms and other high population density areas during school periods (except residence halls) are designated gold permit parking spaces (see map of designated parking permits in Fig. 3). Gold parking permit users are only determined through lottery system. After receiving applications, a faculty/staff drawing is held first with remaining unused permits set aside for the student gold permit drawing. Even though annual volume of applicants barely changes even with price increases, the parking occupancy study showed that gold permits had an average vacancy rate of 12.5% from 10 a.m. to about 2 p.m. Gold permit holders can also park in purple parking spaces.

2.3.2. Light green permits

Designated mainly for residence students, the parking occupancy survey showed that this permit group peaks between 11 a.m. and 12 p.m. with an average vacancy rate of 8.6% (138 spaces). Given that an average area for a parking space in this permit category is 286 square feet, the 138 spaces makes up a total of 39,481 square feet[2] of land. Parking occupancy for this group was almost constant during the school period, signifying a specific user group (resident students) who barely moved their vehicles during the school period.

2.3.3. Dark green permits

The dark green permit is a discount residence hall parking permit category. This permit category had the longest peak period (9 a.m. to 2 p.m.) during the survey with no vacant spaces during this peak period. The long peak period is an indication that these permit holders require longer parking duration which is a characteristic of residential students. Again, the sharp decline in the number of occupied spaces also suggest that these people, although residential students, often move out of campus at later hours in the day and hence do not necessarily need to spend much money purchasing the light green permits.

2.3.4. Purple permits

The peak period for this permit group was recorded between 12 and 1 p.m. peak period, with a vacancy of rate 9% (more than 100 parking spaces). Although not located close to the classrooms and other highly populated areas on campus, the relatively low vacancy rate at peak period can partly be explained by the fact that gold permit users can also use this permit. Even though purple permit holders park at far distances like orange permit holders, these permit holders can also park in orange permit spaces. This

[1] And yet, people have difficulty locating empty spaces to park because space, like any resource, if not well distributed, can be scarce even in abundance.

[2] In January of 2012, NYU planned to use about 40,000 square feet of land to create a public parkland and open space. This proposed land area is almost equal to the 39,481 square feet of unused light green parking spaces at MSU.