Assessing the Impact of Parking Pricing on Travel Demand and Behavior

Sustainable Transportation Seminar

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Parking Pricing as a TDM

Why parking pricing?
• A potentially effective transportation demand management
• Prices neither reflect the true cost of parking nor actual demand
• Uncertain impact on different social groups

Why UC Berkeley?
• Wide range of employment types, income levels, and residential locations
• Located in a region with several transportation alternatives
• Scarce land resources
• Capital and operation costs of parking are higher than parking price, leading to an uneven distribution of parking cost
• Fixed cost annual parking permits
More Parking Permits

Daily Parking Hangtags

The Ultimate Parking Permit

UC Berkeley Nobel Laureates Randy Schekman (Physiology or Medicine, 2013) and Saul Perlmutter (Physics, 2011).

Sources: gettyimages and Graduate Division, UC Berkeley (2014).
Current Studies

Increasing parking pricing decreases parking demand
- San Francisco (Kulash, 1974)
- Portland (Dueker et al., 1998)
- Toronto (Gillen, 1977)
- Dublin (Kelly and Clinch, 2009)
- Sydney (Hensher and King, 2001)

Removing parking subsidies decreases solo driving trips
- Los Angeles (Willson & Shoup, 1990) → 15-38%
- Portland (Bianco, 2000; Hess, 2001) → 60%
Methods and Data Collection

Case Selection
• UC Berkeley Employees (Staff and Faculty Only)

One-on-one Interviews
• May - Sept 2013, n = 86

Focus Group Discussion Sessions
• Nov - Dec 2013, 10 sessions, n = 113

Transportation and Parking Survey
(Revealed and Stated Preferences Data for Discrete Choice Analysis)
• Dec 2013, n = 4,188 (Response Rate ≈ 30%)
The “Other” category (four percent) includes being dropped off, traveling equal distances on more than one transportation mode, using a combination of different modes, and using campus shuttles or UC Berkeley shared vehicles to travel to campus.
Parking Preferences

The “Other” category (eight percent) includes parking at BART stations, the Lawrence Berkeley National Laboratory, parking with disabled person placards or plates either on or off campus, private parking lots under contract with UC Berkeley, and parking on campus Nobel laureate (NL) parking space.
“I park in the residential neighborhood every day and move my car three to four times a day. I use it as a form of exercise and like it.”

“When I used to work part time, I would park far, far away and then I would walk to campus. I am sure other people do that too. That’s how I got my exercise, 20 minutes of walking time. But now I am a full time employee, I got an F permit. Convenience is very important.”

“It’s cheaper to buy a parking permit than to get a ticket. I am anxious enough every day, so stacked parking or not, it’s good to have campus parking and not worry. Remembering where your car is on the street is a problem too.”

“It would depend on the location. If it’s in a sketchy neighborhood, then I would question if the discount (in parking pricing) is really worth it.”

- Various Staff Members
In the following question, you will be shown four types of parking options and you will be asked to indicate which one of the four options would you choose, assuming that these are the only paid parking options available. You may select "None of the Options" if you choose not to drive to campus or drive but park elsewhere.

Option A: A monthly campus parking permit with unlimited access. If you are carpooling, a carpool permit costs 34% of the cost of parking shown in the table below, which is comparable to the current campus parking pricing for each carpool user.

Option B: A monthly restricted campus parking permit for parking 3 days a workweek (unlimited on weekends). If you are carpooling, a carpool permit costs 34% of the cost of parking shown in the table below, which is comparable to the current campus parking pricing for each carpool user.

Option C: A daily campus parking permit, without any restriction on the number of permits that can be purchased annually. Daily permits can be purchased from parking machines at any campus parking garage/lot.

Option D: Hourly parking at an off-campus location with no time limit enforcement.

<table>
<thead>
<tr>
<th></th>
<th>Option A</th>
<th>Option B</th>
<th>Option C</th>
<th>Option D</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cost of Parking</td>
<td>$180/month</td>
<td>$108/month</td>
<td>$9/day</td>
<td>$0.60/hour</td>
</tr>
<tr>
<td>Parking Fee Refund</td>
<td>$1/day</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>for Days Not Parked</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Free Monthly Pass</td>
<td>Yes</td>
<td>No</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>for AC Transit and</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>BART</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Walking Time from</td>
<td>8 min</td>
<td>8 min</td>
<td>3 min</td>
<td>18 min</td>
</tr>
<tr>
<td>Parking Space to</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Office</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Which one of the four parking options would you choose?

Option A  
Option B  
Option C  
Option D  
None of the Options
# SP Choice Experiment Design

Full factorial design  
$= 8^2 \times 3 \times 2  
= 384$ profiles

<table>
<thead>
<tr>
<th>Attributes</th>
<th>Levels</th>
</tr>
</thead>
<tbody>
<tr>
<td>Parking Option</td>
<td>A, B, C, D</td>
</tr>
</tbody>
</table>
| Cost                                           | Percentage Increase:  
| Parking Option A                               | $0\%, 10\%, 25\%, 40\%, 70\%, 100\%, 120\%, 150\%$ |
| $90/month (Base Price)                         |                                             |
| Parking Option B-3                             | Percentage Increase:  
| (3 days/week parking permit)                   | $48\%, 50\%, 58\%, 60\%, 72\%, 78\%, 86\%, 95\%$ |
| Pivoted against Option A                       |                                             |
| Parking Option B-4                             | Percentage Increase:  
| (4 days/week parking permit)                   | $60\%, 65\%, 74\%, 80\%, 86\%, 89\%, 93\%, 97\%$ |
| Pivoted against Option A                       |                                             |
| Parking Option C                               | Percentage Increase:  
| Pivoted against Option A                       | $17\%, 18\%, 19\%, 20\%, 22\%, 27\%, 30\%, 36\%$ |
| Parking Option D                               | Percentage Increase:  
| $0.30/hour (Base Price)                        | $0\%, 100\%, 67\%, 25\%, 20\%, 17\%, 14\%, 13\%$ |
| Parking Fee Refund for Days Not Parked         | $0, \$1/day, \$2/day                        |
| Free Monthly Pass for AC Transit (and BART)    | Yes, No                                     |
| Walking Time from Parking Space to Office      | 1 min, 3 min, 5 min, 8 min, 10 min, 15 min, 18 min, 20 min |
Discrete Choice Analysis: Multinomial Logit Model

Utility Function

\[ U_{in} = \beta_i X_{in} + \varepsilon_{in} \]

- \( U_{in} \) = utility of the \( i \)th alternative for the \( n \)th individual
- \( \beta_i \) = vector of unknown parameters (estimated from data)
- \( X_{in} \) = vector of known variables (include attributes and characteristics)
- \( \varepsilon_{n} \) = random utility component

Example

\[ U_{PA} = \alpha_{PA} + \beta_{Cost} PA \text{ Cost} + \beta_{WKTMD} PA \text{ WKTMD} \]

- \( U_{PA} \) = utility of Parking Option A
- \( \alpha_{PA} \) = alternative specific constant for Parking Option A
- \( \beta_{Cost} \) = parameter for the cost of Parking Option A
- \( \beta_{WKTMD} \) = parameter for walking time
Findings from SP Parking Choice Model (1): Value of Walking Time

Value of Walking Time = Marginal Rate of Substitution (MRS) of Walking Time from Parking Location to Primary Workplace

\[
\text{MRS}_{\text{Walking Time-Cost}} = \frac{\partial U}{\partial \text{Walking Time}_{PB}} = \frac{\beta_{\text{Walking Time}}}{\beta_{\text{Parking Cost}}}
\]

<table>
<thead>
<tr>
<th></th>
<th>Value of Walking Time ($/min)</th>
<th>Value of Walking Time ($/hr)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Full Sample (Restricted Model)</td>
<td>0.25</td>
<td>14.87</td>
</tr>
<tr>
<td>Full Sample (Final Model)</td>
<td>0.25</td>
<td>14.71</td>
</tr>
<tr>
<td>Low Income: less than $90,000</td>
<td>0.22</td>
<td>13.43</td>
</tr>
<tr>
<td>Medium Income: $90,000 - $119,000</td>
<td>0.26</td>
<td>15.45</td>
</tr>
<tr>
<td>High Income: greater than $119,000</td>
<td>0.27</td>
<td>15.99</td>
</tr>
</tbody>
</table>

Value of Walking Time for Full Sample = 44% of Average Wage Rate
Findings from SP Parking Choice Model (2): Price Elasticity of Parking Demand

<table>
<thead>
<tr>
<th></th>
<th>Unlimited Monthly Parking</th>
<th>Restricted Monthly Parking</th>
<th>Hourly Parking</th>
<th>Daily Parking</th>
</tr>
</thead>
<tbody>
<tr>
<td>Full Sample</td>
<td>-0.97</td>
<td>-1.10</td>
<td>-1.19</td>
<td>-1.22</td>
</tr>
<tr>
<td>Low Income: less than $90,000</td>
<td>-1.06</td>
<td>-1.21</td>
<td>-1.30</td>
<td>-1.34</td>
</tr>
<tr>
<td>Medium Income: $90,000 - $119,999</td>
<td>-0.92</td>
<td>-1.05</td>
<td>-1.13</td>
<td>-1.16</td>
</tr>
<tr>
<td>High Income: greater than $119,999</td>
<td>-0.89</td>
<td>-1.02</td>
<td>-1.09</td>
<td>-1.12</td>
</tr>
</tbody>
</table>
Findings from SP Parking Choice Model (3): Transit and Pricing Incentives

Significant Attributes in Choice Set ($p = 0.00$)

- Parking fee refund for Parking Option A (0.09)
- Free transit pass for Parking Options A & B (0.28 & 0.47)
- BART pass dummy (0.14)
“Subsidizing transit would be great, like what students get for AC Transit.” (Occasional Driver, Biker)

“If I have a transit pass, I will use the bus more because the bus passes my house. I will use it every day.” (Occasional Driver, Carpooler)

“I feel that UC could do more, $10 isn’t much.” (BART User)

“I would use it once in a while for going home, but it’s not reliable enough for going to work.” (BART User)

“Why is this not available for BART yet?” (Occasional Driver, Biker)

- Various Staff Members
Findings from SP Parking Choice Model (4): Socioeconomic Factors

Heterogeneity of Individuals

- **University affiliation**
  - Staff members are more likely to choose monthly parking options more than faculty
- **Income** (significant for all parking options)
  - Higher income households prefer monthly and daily parking options over hourly option
- **Age**
  - Older employees are more likely to choose unlimited monthly parking options than hourly parking option ($0.07, \ p = 0.02$)
Findings from SP Parking Choice Model (5): Scheduling Factors

Work Schedule Factors

• **Arrival Time** – only significant for monthly parking options
  \((0.31, p = 0.02; 0.27, p = 0.03)\)

• **Departure Time** – also only significant for monthly parking options
  \((-0.38, p = 0.00; -0.34, p = 0.01)\)

• Having a **second office** decreases utilities for all parking options

• The longer the **time spent on campus** (hours/day and days/week), the more likely employees will choose to park monthly parking options over daily parking option
# Parking Pricing Scenarios

<table>
<thead>
<tr>
<th>Scenario</th>
<th>On-Campus Parking ($ per day)</th>
<th>Off-Campus Parking ($ per day)</th>
<th>Carpool Campus Parking ($ per day)</th>
<th>Transit Fare ($ per trip)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Baseline</td>
<td>2.25 – 16.00</td>
<td>0 - 13.36</td>
<td>1.45 - 2.20</td>
<td>1.85 – 36.00</td>
</tr>
<tr>
<td>(Current Prices)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>9.00</td>
<td>8.00</td>
<td>4.50</td>
<td>0.00</td>
</tr>
<tr>
<td>2</td>
<td>16.00</td>
<td>8.00</td>
<td>8.00</td>
<td>0.00</td>
</tr>
<tr>
<td>3</td>
<td>20.00</td>
<td>8.00</td>
<td>10.00</td>
<td>0.00</td>
</tr>
</tbody>
</table>

![Graph showing mode share for different scenarios](image)

- **Blue** Drive alone and park on campus
- **Red** Drive alone but not park on campus
- **Green** Carpool
- **Purple** Motorcycle
- **Teal** Transit
- **Orange** Bicycle
- **Light Blue** Walk only
- **Pink** Work at home
- **Green** Not on campus
Percentage Changes in Mode Share

![Chart showing percentage changes in mode share across different scenarios.](chart.png)
Conclusions

Changes in pricing have to be coupled with other incentives.

“Free” off-campus parking locations serve as alternatives can influence impact of parking pricing.

Frequency of commute trip and duration of stay on campus affect parking location type.

Differences in value of walking time provide insights to optimal parking locations.
Thank You

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