

Impacts of Parking Pricing and Parking Management on Passenger Vehicle Use and Greenhouse Gas Emissions

Policy Brief

**Steven Spears, University of California, Irvine
Marlon G. Boarnet, University of Southern California
Susan Handy, University of California, Davis**

September 30, 2014

Policy Brief: http://www.arb.ca.gov/cc/sb375/policies/pricing/parking_pricing_brief.pdf

Technical Background Document:

http://www.arb.ca.gov/cc/sb375/policies/pricing/parking_pricing_bkgd120313.pdf

California Environmental Protection Agency

 **Air Resources Board**

Policy Brief on the Impacts of Parking Pricing and Parking Management on Passenger Vehicle Use and Greenhouse Gas Emissions

Steven Spears University of California, Irvine
 Marlon Boarnet, University of Southern California
 Susan Handy, University of California, Davis

Policy Description

Increasing existing parking prices, or charging for parking that is currently offered for free, has the potential to reduce vehicle travel (as measured by vehicle miles traveled (VMT)) and encourage mode switching by increasing the cost of private vehicle trips. As a result, it may also have the potential to reduce greenhouse gas emissions. Several parking pricing strategies exist, including:

- **Long/Short-Term Fee Differentials:** Charging different fees for short versus long-term parking can change turnover rate and user mix. For instance, implementing higher fees for long-term parking can help to discourage commuter parking and make more spaces available for shoppers and other short-term users. Such a policy has the potential to encourage car pooling and mode switching without hindering commercial activity.
- **On-street Fees and Resident Parking Permits:** These tools can be used to manage parking congestion and increase turnover to favor short-term parking. Resident parking permits can help to control spillover of commuter parking into residential areas, and can play an important parking demand management role in conjunction with workplace or commercial parking policies.
- **Workplace Parking Pricing:** Studies have found that approximately 95 percent of employees park at their workplace for free. Because free workplace parking is primarily the result of employer subsidies, programs have targeted these subsidies in an attempt to manage private vehicle travel demand. Other examples of workplace parking pricing include charges for single occupant vehicles and cash-out programs that offer employees cash in lieu of subsidized parking.
- **Reduced Reliance on Minimum Parking Standards:** Minimum parking requirements, usually based on the type and square footage of a parcel's land use, have long been common in U.S. cities (Weinberger, et al., 2010). These requirements often result in an over-supply of parking. Willson (1995), in a study of ten developments in southern California, found that seven of the ten built exactly the minimum parking required and that peak-period parking utilization rates were 56 percent in five "typical" sites and 72 percent in five "special" sites, suggesting that the minimum standard led to excess supply of on-site parking. A few cities, such as Boston, Portland, and New York City, eliminated minimum parking requirements for development projects in the 1970s, and San Francisco instituted a maximum rather than a minimum parking requirement (Weinberger, et al. 2010).
- **Adaptive Parking Pricing:** Adaptive pricing adjusts parking prices to obtain a target on-street occupancy rate. It does this by varying the prices by location and time of day to balance parking supply with demand on a block-by-block basis. This is the most sophisticated use of pricing to manage parking demand. San Francisco pioneered the

use of adaptive parking pricing with *SFpark*, which was implemented in seven pilot zones in 2011.

Impacts of Parking Pricing

Effect Size

While a number of studies have examined the effect of pricing policies on parking demand, relatively few have focused on the impact of parking pricing on VMT. Often, parking pricing is included as one component of a bundle of travel demand management (TDM) and infrastructure measures, making separate evaluation difficult. Travel demand management is the term for policies that are designed to affect the amount, time, or place that people travel.

Of the studies that examine VMT, most deal with impacts of workplace parking subsidy elimination at individual sites. In these cases, the literature indicates that parking pricing policies can produce moderate VMT reductions among employees who accept parking cash-outs. In an examination of the VMT impacts in California, Shoup (1997) found a 12 percent VMT reduction among individuals who accepted a parking subsidy cash-out.

Modeling of parking pricing has indicated a smaller impact on regional VMT. A study of four California regions conducted by Deakin, et al. (1996) indicated regional VMT reductions of 2.3 to 2.9 percent were possible if solo commuters were charged \$3.00 per day for workplace parking. A similar study, using the same pricing level, estimated regional VMT reductions of 1.9 percent for Seattle (Dueker, et al., 1998). An analysis of 16 parking pricing studies by Rodier (2008), which included studies of six European cities and those noted above, yielded a median regional VMT reduction of 2.2 percent. In the U.S. studies, parking charges were evaluated at levels of \$1 and \$3 per day. The European studies used prices set at 20 percent and 60 percent of the value of commuters' travel time. Prices were evaluated in study year dollars.

In terms of demand for parking spaces, several studies (Kelly and Clinch, 2009; Gillen, 1977; Kulash, 1974) have indicated that every 10 percent increase in parking charge results in a 3 percent decrease in demand for parking spaces. However, Dueker, et al. (1998) estimated a decrease of 5.8 percent per 10 percent price increase for single occupant vehicle commuters in urban Portland, using a base parking charge of \$80 per month. When the base charge was \$20 per month, the demand for workplace parking places dropped 1.2 percent when parking prices increased 10 percent, illustrating the effect of the baseline parking charge level on demand for spaces. Shoup's (1994) study of parking subsidy effects found parking demand at workplaces in the California, Washington D.C., and Ottawa, Ontario fell an average of 1.5 percent for every 10 percent increase in parking prices.

Relating parking space demand to changes in VMT can be problematic, however, as drivers may attempt to avoid parking charges or select alternative destinations, especially for shopping trips. Parking policy may also lead to larger than expected changes in driver behavior, despite relatively small changes in parking space demand. For example, Shoup (1994) found employer subsidy eliminations led to an average decrease of 25 percent in solo commuter parking, despite a much smaller decrease in parking space demand. Studies have found that these effects, as well as long-term changes in residential and business location, can impact the effectiveness of parking pricing programs (Lautso, et al., 2004). Table 1

summarizes the effect sizes for the parking pricing studies presented here.

All of the studies presented in this brief were conducted in urbanized areas. Therefore the results may not be applicable outside of an urban context. The *SFpark* program was recently evaluated by Pierce and Shoup (2013) who calculated the effect of price changes on on-street parking occupancy. The results are not included in Table 1 because Pierce and Shoup did not evaluate the link from *SFpark* to VMT or GHG changes.

Table 1: Summary of Parking Price Studies

Study	Study Location	Study Year(s)	Results	
			Effect Type	Effect Size
Deakin et al. 1996	4 California regions	1991	Regional VMT Change	-1.0% for \$1/day charge -2.6% for \$3/day charge
Dueker et al. 1998	Seattle region	1990	Regional VMT Change	-1.9% for \$3/day charge
Lautso et al. 2004	7 European cities	2002	Regional VMT Change	-2.8% average for price increase= 60% of commute time cost
Shoup 1997	8 workplaces in Southern California	1993-95	Individual employee VMT Change	-12% for employees who chose parking cash-out
Shoup 1994	Ottawa, Canada, Washington D.C, 5 sites in LA	1986	Change in parking space demand for 1% price increase	-0.15% average
Kelly and Clinch 2009	Dublin, Ireland	2001	Change in parking space demand for 1% price increase	-0.29% average
Henscher and King 2001	Sydney, Australia	1998	Change in parking space demand for 1% price increase	-0.54% close-in CBD -1.01% elsewhere in CBD -0.48% on CBD fringe
Kulash 1974	San Francisco	1970-73	Change in parking space demand for 1% price increase	-0.3% average
Dueker et al. 1998	Portland	1990	Change in parking space demand for 1% price increase	-0.58% at \$80/mo base price -0.12% at \$20/mo base

Evidence Quality

The available evidence on the direct impact of parking pricing on VMT is relatively scarce. In addition, much of the evidence that does exist was obtained from studies that are now at least 15 years old. However, the results of various modeling exercises conducted for urban regions

worldwide have yielded similar results. Likewise, evidence on the price effects on parking space demand has proved quite robust. Studies conducted in the U.S. and abroad indicate general agreement that every 10 percent increase in parking price produces a reduction of approximately 3 percent in the demand for parking spaces.

Caveats

Parking pricing measures are often implemented and modeled as part of a comprehensive package of travel demand management measures. Careful consideration must be given to situations where alternatives to car commuting are lacking or where parking alternatives exist, as these conditions may lead to deviations from the results indicated here. For example, at locations where alternate parking was available, studies have found parking demand may decrease at rates equal to price increase. (Hensher and King, 2001; Vaca and Kuzmyak, 2005) At the regional level, consideration must also be given to the potential decentralizing effects of parking pricing on both residences and businesses, especially where differences in pricing policy exist between localities. In cases where parking prices are increased in one locality, households and businesses may choose to relocate to lower priced areas in the longer term.

Several studies have found that workplace parking pricing has the potential to significantly discourage single-occupant commuting trips, despite small sensitivity of parking demand to price increases (Shoup, 1997; Shoup, 1994). More information is needed, however, on the relationship between individual commuter VMT reduction and overall household VMT.

Greenhouse Gas Emissions

Adaptive parking pricing has the promise of reducing “cruising” for parking. Studies have shown that in some urban neighborhoods (particularly busy commercial districts) more than half of the vehicles on the street can be cruising – literally circling blocks looking for available on-street parking (Pierce and Shoup, 2013). Shoup (2007) estimated cruising times in Westwood neighborhood in Los Angeles, near the UCLA campus, where curbside parking was metered but at rates about half what was charged for off-street parking. In the study reported in Shoup (2007), research assistants circled the block until they found an open on-street parking space. The average cruising distance was half a mile, which when multiplied by the number of parking spaces and observed parking turnover rates implied 4,000 VMT per day spent cruising, or 730 tons of CO₂ emitted per year from cruising for parking in the Westwood neighborhood. By adjusting the price to maintain open parking spaces, adaptive parking pricing has the potential to reduce both VMT and GHG emissions. Millard-Ball et al. (2014) studied the first two years of SF*park* and estimated that the adaptive parking pricing program reduced cruising by 50 percent relative to what was estimated for control blocks that were not part of the adaptive pricing program.

Co-Benefits

Potential co-benefits that could be realized through parking pricing include increased commercial activity and congestion relief. Commercial activity may be enhanced by using parking pricing strategies that free up space in business districts that would otherwise be taken by commuters. This may be accomplished through peak period surcharges or differential parking rates. In addition, decreasing demand for parking space through pricing

may make more space available for development or preservation as open spaces.

To some extent, parking pricing may provide congestion relief by using pricing strategies that encourage parking around the outside of congested central business districts (CBDs). Where congestion is lowered within CBDs, local air pollution may be reduced as well. To be effective, alternatives must be available that will allow completion of trips into the CBD by non-car modes.

Examples

In 1992, California enacted a parking cash-out law. The law required employers in air quality non-attainment areas with more than 50 employees to offer a cash allowance in lieu of a parking space. The parking cash-out helps to reduce congestion and air pollution by reducing the number of employees who drive alone to work. Receiving cash in lieu of a parking subsidy encourages employees to take transit, carpool, walk, or bicycle to work. Shoup (1997) found that employees of businesses that offer cash-outs reduce their vehicle miles traveled by an average of 12 percent.

In 1980-81, Madison, Wisconsin instituted a parking pricing demonstration program whose purpose was to discourage private vehicle commuting and make more parking spaces available for shopping and personal business. To accomplish this, a surcharge was applied to parking during the peak morning commute hours. The surcharge resulted in a 40 percent reduction in the number of spaces occupied in the peak period. A survey of those who changed their behavior during the program found that 18 percent of respondents used a different mode to travel downtown. More than half of these cited the surcharge as the reason for the change.

SFpark is a particularly promising example of adaptive parking pricing (see Pierce and Shoup, 2013 for the description that follows.) The program was implemented in seven San Francisco neighborhoods using an \$18 million U.S. Department of Transportation Value Pricing Pilot Program grant, with operation beginning in 2011. Sensors detect when an on-street parking space is occupied, and based on occupancy measures, metered prices are adjusted every six weeks to maintain a target occupancy of 60 to 80 percent of the parking spaces. Metered prices can vary for each block and can be different in the morning, mid-day, and afternoon time periods. Price adjustments are made in increments of -25 cents, -50 cents, and +25 cents per hour. If occupancy levels are above 80 percent, the price on that block is raised, and if occupancy levels are below 60 percent the price on that block is lowered. Pierce and Shoup (2013) found that on average, prices across the seven pilot neighborhoods dropped by one percent, with some neighborhoods experiencing price increases and others experiencing price decreases, suggesting that adaptive parking pricing has the potential to be revenue neutral. The *SFpark* example has inspired similar programs in Los Angeles (Pierce and Shoup, 2013).

References

Deakin, E., Harvey, G., Pozdena, R., & Yarema, G. (1996). *Transportation Pricing Strategies for California: An Assessment of Congestion, Emissions, Energy and Equity Impacts*. Final Report. Prepared for California Air Resources Board, Sacramento, CA.

- Dueker, K. J., Strathman, J. G., & Bianco, M. J. (1998). *Strategies to Attract Auto Users to Public Transportation*. TCRP Report 40, Transportation Research Board, Washington, D.C.
- Hensher, D. A., & King, J. (2001). Parking Demand and Responsiveness to Supply, Pricing and Location in the Sydney Central Business District. *Transportation Research Part A* 35, 177-196.
- Kelly, J.A., & Clinch, J. (2009). Temporal variance of revealed preference on-street parking price elasticity. *Transport Policy* 16(4), 193-199.
- Kulash, D., 1974. Parking Taxes as Roadway Prices: A Case Study of the San Francisco Experience. The Urban Institute, Paper 1212-9, Washington, D.C.
- Lautso, K., Spiekermann, K., Wegener, M., Sheppard, I., Steadman, P., Marino, A., Domingo, R., Gayda, S. (2004). PROPOLIS: Planning and Research of Policies for Land Use and Transport for Increasing Urban Sustainability: Final Report, European Commission, Energy, Environment, and Sustainable Development Thematic Programme.
- Marsden, G. (2006). The evidence base for parking policies-a review. *Transport Policy* 13, 447-457.
- Millard-Ball, A., Weinberger, R.R. & Hampshire, R.C. (2014). Is the curb 80% full or 20% empty? Assessing the impacts of San Francisco's parking pricing experiment. *Transportation Research Part A* 63, 76-92.
- Pierce, G. & Shoup, D. (2013). Getting the Prices Right: An Evaluation of Parking Pricing by Demand in San Francisco. *Journal of the American Planning Association* 79(1), 67-81.
- Shoup, D.C. (2005). *The High Cost of Free Parking*. APA Planners Press, Chicago.
- Shoup, D. (2007). Cruising for Parking. *ACCESS Magazine* 30(Spring), 16-22.
- Shoup, D. (1997). Evaluating the Effects of Cashing Out Employer-Paid Parking: Eight Case Studies. *Transport Policy* 4(4), 201-216.
- Shoup, D. C. (1994). Cashing Out Employer-Paid Parking: An Opportunity to Reduce Minimum Parking Requirements. University of California Transportation Center Working Paper, Berkeley, CA
- Vaca, E. & Kuzmyak, J.R. (2005). Parking Prices and Fees: Traveler Response to Transportation System Changes. Paper presented at the Annual Meeting of the Transportation Research Board, Washington, D.C .
- Weinberger, R., J. Kaehny and M. Rufo. (2010). *U.S. Parking Policies: An Overview of Management Strategies*. New York, NY: Institute for Transportation and Development Policy. Available at http://media.oregonlive.com/portland_impact/other/ITDP-Parking-Report.pdf.

Willson, R. W. (1995). Suburban parking requirements: a tacit policy for automobile use and sprawl. *Journal of the American Planning Association* 61(1), 29-42.

Acknowledgments

This document was produced through an interagency agreement with the California Air Resources Board with additional funding provided by the University of California Institute of Transportation Studies MultiCampus Research Program on Sustainable Transportation and the William and Flora Hewlett Foundation.