

## Towards Peak-Load Pricing in Metropolitan Areas: Modeling Network Activity

**Principal Investigator:** Peter Gordon  
Sol Price School of Public Policy  
University of Southern California  
Los Angeles, CA 90089-0626  
**Email:** [pgordon@usc.edu](mailto:pgordon@usc.edu)

**Research Associate:** Qisheng Pan  
Department of Urban Planning and Environmental Policy  
Texas Southern University  
Houston, TX 77004  
**Email:** [pan\\_qs@tsu.edu](mailto:pan_qs@tsu.edu)

### Project Objective

Most transportation analysts agree that travel along congested routes is underpriced because uncompensated externalities inevitably occur. There is also widespread agreement that a policy of peak-load pricing is called for. But which prices should be implemented where and at what hours? What would be the effect throughout the network, including on the un-tolled paths? What would be the effects on development pressures throughout the area? Can land use-transportation modeling be useful in answering these questions? We sought to address these questions.

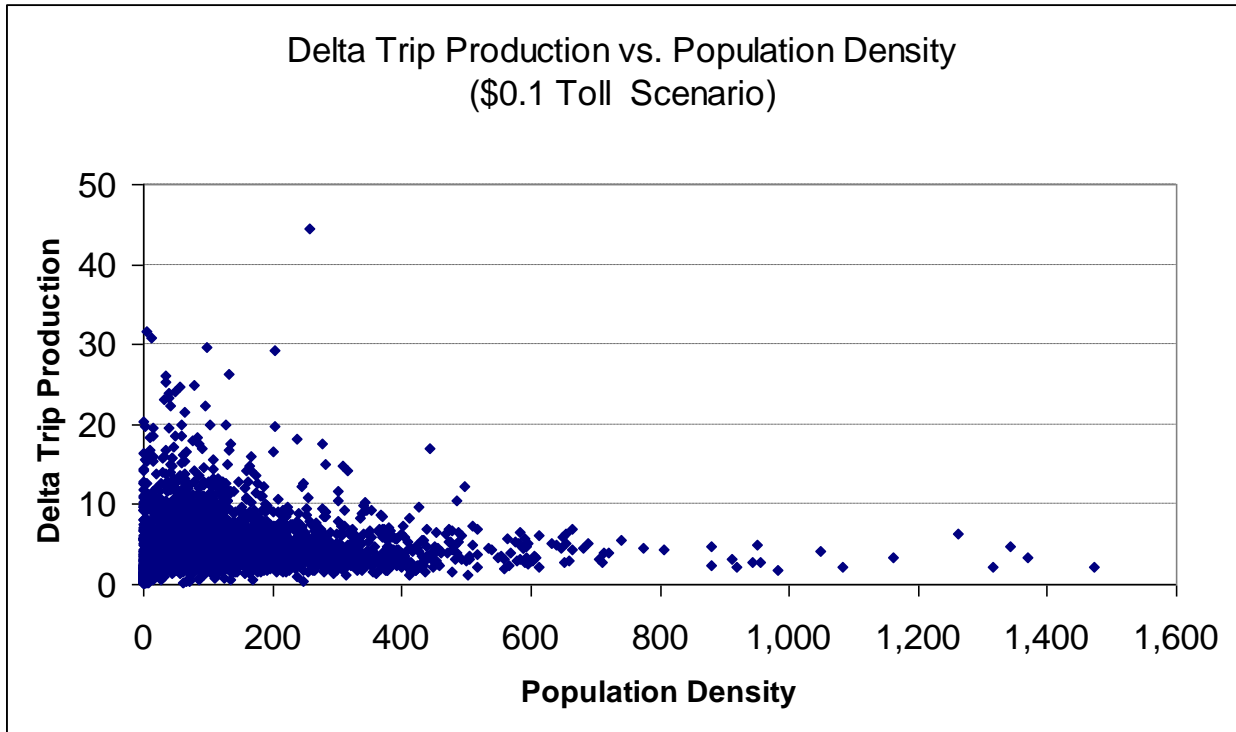
### Problem Statement

Peak load pricing has long been seen as a way to internalize externalities, as a set of incentives to shift peak hour trips to off-peak periods, and as a mechanism to generate revenues. However, how travelers trade time for money and respond to peak-off-peak pricing differentials is an open question that generates some timely and related questions, including the following: (a) How can the activity location and traffic implications for multiple times of the day in a major metropolitan area be modeled? (b) What are the network effects of peak load pricing on selected routes on level of service and urban development? It is possible to conduct simulations on actual highway networks to treat these questions. None of the urban models, however, can examine simultaneous route choice and time-of-day choice involving millions of travelers, thousands of traffic network zones, and hundreds of thousands of network links in an equilibrium system. This research addressed these questions by extending the Southern California Planning Model so that it could be used to determine the effects of pricing schemes on the time-of-day choice for travel, trip distribution, and network traffic for the greater Los Angeles, California (five-county), metropolitan area. The model estimated improvements in levels of service throughout the highway network for alternative toll charges. The model examined how drivers traded route choice with time-of-day choice against the option of traveling less. The approach also estimated the revenues implied for local jurisdictions as well as the possible effects of altered development pressures on land use throughout the region. The effects of two different toll scenarios were compared, and policy implications were offered.

### Research Methodology

Our approach was to elaborate the Southern California Planning Model (SCPM) so that the route choice decisions of travelers were influenced by both the time and money costs of traversing any path. A new version of SCPM is developed to facilitate an understanding of the actual effects of peak load pricing on a complex land use-transportation system, including impacts on the performance of a transportation network at the link level and the effects of activities at the traffic analysis zone (TAZ) level. It inherits all the capabilities of the previous versions and adds time-of-day functions to model a.m. peak, p.m. peak, and off-

peak traffic. It replaces the network equilibrium model by a newly developed module for user equilibrium with variable demand (UE-VD). The effects of various cash tolling policies on any set of routes could then be studied for effects on traffic throughout the region and also consequent changes in development pressures. We selected two pricing regimes and tested the effects on all major routes and all major zones of the Southern California metropolitan region.



Change in Passenger Trip Production vs. Population Density

## Results

We identified predicted changes for total trips (average and total trip times) as well as changes for the freeway and surface street components in different cash toll scenarios. For demonstration purposes, we tested and analyzed just two across-the-board tolling scenarios. We found that, depending on the scenario, the extent to which drivers used tolled vs. untolled segments, varied substantially. Assuming that there are 250 days of the year in which congestion tolling occurs, the lower toll (\$0.10/mile) transfers substantially more revenue to the tolling authority than would the higher toll (\$0.30/mile), \$1,420 million vs. \$550 million. The higher toll moves trip volumes from the peaks to the off-peak periods, but the trip volume effects for the lower toll are very minor.

Both tolls cause improvements in average and total freeway travel times, *but* at the cost of increased travel times on non-tolled surface streets. The trade-off facing policy makers is complex: internalized externalities vs. improved peak-hour levels-of-service vs. greater revenues collected. Notably, improved levels of service on tolled freeways come at the expense of greatly increased use of surface roads. We also found that there is no association between TAZ population density and changes in trips produced.

Most analysts expect that a priced network will bring about higher densities and a less spread out (less sprawled) metropolitan area. Our study found development pressures shift downward across the board for the higher toll while they shift upward across the board for the lower toll as shown in the Figure above.