DRISI
Caltrans Division of Research, Innovation and System Information

Research Results

# Welfare Changes from Curbside Parking Occupancy Rates

Inferring welfare changes from stochastic modelling of optimal curbside occupancy rates.

Planning, Policy and Programming

**MAY 2019**

**Project Title:**
Towards Inferring Welfare Changes from Changes in Curbside Parking Occupancy Rates: A Theoretical Analysis Motivated by SF Park and LA Express Park

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**Task Manager:**
David Chursenoff
Associate Transportation Planner
david.chursenoff@dot.ca.gov

## WHAT IS THE NEED?

Cruising for curbside parking is an often neglected source of traffic congestion in downtown areas. Because curbside parking is largely under communal ownership and free to the driving public, excess demand is often created for what is a limited supply of parking spaces. From this, a certain volume of Vehicle Miles Travelled are spent not on delivering drivers from their origins to their destinations but on parking their vehicles within proximity of their destinations.

## WHAT WAS OUR GOAL?

The goal of this study was to develop a conceptual and analytical framework for calculating the optimal target curbside parking occupancy rate around a circle using stochastic microsimulation to investigate the probability distribution of the cruising-for-parking times as a function of the expected occupancy rate, parking duration and number of parking spaces.

## WHAT DID WE DO?

This research had two components, both of which relate to curbside parking policy.

The first was to develop the theoretical foundations of the “optimal target curbside parking occupancy rate”. Donald Shoup has advocated for the adoption of such a rate, initially suggesting 85%. Curbside parking fees by block and by time of day would be set to achieve this common rate. The parking

management programs SFpark and LAExpress Park have experimented with applying Shoup's proposed procedure. Since SFpark in particular has received international exposure, if Shoup's proposed procedure is successful, it is likely to be adopted in many cities around the world to determine curbside parking meter rates. The team developed a mathematical model determining the microfoundations of the optimal curbside parking occupancy rate.

The second was to investigate the distribution of cruising-for parking times as a function of the occupancy rate via (stochastic) traffic microsimulation. This distribution is one element of the information needed to calculate the optimal target curbside parking occupancy rate. Several microsimulations were run, each corresponding to a different set of parameter values. For each, one million cars were simulated cruising round a circle in search for curbside parking.

## WHAT WAS THE OUTCOME?

With regard to the theoretical foundations of the "optimal target curbside parking occupancy rate," the theoretical work generated the negative result that Shoup's proposal to adopt a common (the same over different blocks and times of day) target curbside parking occupancy rate is not theoretically justified. On the positive side, the theoretical work showed how block/time-of-day-specific target curbside occupancy rates can be determined (what data would be needed and how these data should be used). The theoretical work obtained the result that the target curbside occupancy rate should be higher on blocks and at times of day when the demand for curbside parking relative curbside parking capacity is higher.

Regarding the distribution of cruising-for-parking times as a function of the occupancy rate, the standard procedure that has been used to calculate expected cruising-for-parking time as a function of the occupancy rate is inaccurate and at high occupancy rates very inaccurate, underestimating expected cruising-for-parking times by an order of magnitude at high occupancy levels. This finding implies that curbside parking rates should be higher than was previously believed to be efficient so as to achieve lower curbside occupancy rates than were previously advocated. Analysis (statistical and analytical) of the microsimulation results demonstrates how complex the cruising-for-parking process becomes at high occupancy rates, and how fat the right tail is. This finding implies that, at high curbside parking occupancy rates, considerable efficiency gains can be had through "truly" responsive pricing, which responds to actual parking conditions (as was advocated by Nobel Prize winner William Vickrey in the 1950's!).

## WHAT IS THE BENEFIT?

The cruising induced from searching for curbside parking contributes to traffic congestion, causes accidents, wastes fuel, pollutes the air and degrades the surrounding pedestrian environment. Enforcing an optimal target occupancy rate for curbside parking will aid cities in solving these transportation-related issues. However, there is still more research which must be conducted before these occupancy rates can be fully calculated and deployed in the real world.

## IMAGES

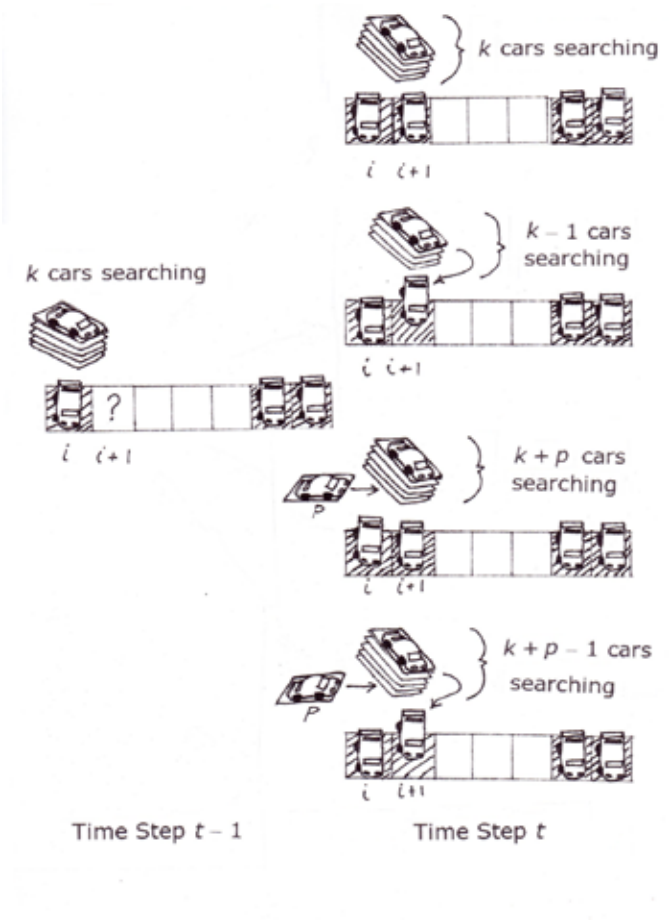


Figure 2B from final report:Cartoon of the Transitions from Time Step t - 1 to Time Step t with No Exits from Parking