Approaches to the Mitigation of Traffic Congestion: A Very Short Survey

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Traffic Congestion: What Can and Should Be Done?

- It Depends on the Nature of the Problem
  Downtown congestion, Radial route congestion, Circumferential route congestion, Bottlenecks
- It Depends on What is Technically Feasible
  Public transit system
  Can construction help?
  How much of road system can be covered by tolls?
- It Depends on What the Public Will Accept
  Is access to new capacity required?
Types of Toll Systems

- City center cordon
  - London, Singapore, New York (?)
- Toll rings
- Downtown parking tax
  - Chicago (?)
- Radial line tolls
- Single facility pricing
  - SR-91 in Orange County, toll bridges
- Area-wide congestion pricing
- Gas tax
Monocentric Urban Area Example: Chicago in 1956

- Chicago in 1956 was basically monocentric with 29% of total employment in CBD; 55% of those trips to CBD were by transit. Only half (53%) of trips to work were during 7-9 am.
- McDonald (2009) calculations suggest moving 10% of households closer to CBD would result in efficient population distribution, given employment locations.
- Alternatives include increasing transit riders and/or shift work trips to other times of day.

Basics of Highway Traffic Flow

• Imagine a circular track, one mile in circumference and with one lane.
• The track has 80 cars moving at a speed of 25 mph.
• Each car crosses the “finish line” 25 times per hour.
• Traffic volume (V) is 2000 cars per hour.
• Traffic density (D) is 80 cars per mile.
• Average speed (S) is 25 mph.
• V = D * S; or S = V/D; or D = V/S.
Production Function Analogy

• Traffic volume (a flow per hour) is the output.
• The inputs are the fixed highway (capital K) and the variable number of cars (D, each equipped with a driver).
• An hour’s worth of 80 cars and drivers produces traffic volume of 2000, with average product of 25 miles per hour.
• Production function is $V = V(D, K)$
• What does $V(D, K)$ look like?
Traffic Volume on the Eisenhower

• Data from IDOT can be used to estimate the production function for hourly traffic volume.
• Data are from the western half of the Ike during rush hour for a week without rain…
• Data source gives “occupancy rate” rather than traffic density, but if each car is 20 ft. in length, 80 cars per mile translates into occupancy of 30.3%. More general formula is

\[ \text{Occ} = \frac{D \times L}{5280}; \ L \text{ is car length.} \]
Empirical Estimate

\[ V = -18,008 - 522.4 \text{ Occ} + 11,394 \ln(\text{Occ}) \]

\[ (11.3) \quad (15.2) \quad (14.8) \]

\[ \text{R sq.} = .614, \quad N = 150 \]

\[ V \text{ is hourly traffic volume on 3 lanes; mean = 5165,} \]
\[ \text{range 4048 to 6235} \]

\[ \text{Occ is occupancy rate, mean = 23.6%,} \]
\[ \text{range 12.80\% to 37.70\%} \]

\[ V \text{ is a maximum at 5718 (1906 cars per lane per hour), Occ = 21.8\%.} \]
Welcome to the Ike

• The empirical estimate implies that traffic volume falls if occupancy is greater than 22%.

• The actual mean occupancy rate was 23.8%, so

• The Ike was operating below maximum traffic volume because of high traffic density over 50% of the time during rush hours.

• We have a big problem.
Road Pricing Options for Metropolitan Chicago: Some Background Facts

• We have a tollway system with high-tech toll collection technology – good news.

• Our traffic congestion problems are severe on the radial expressways and on the circumferential tollway – often in both directions at the same time.

• We have trucks moving freight on the radial expressways (from one rail yard to another?). This looks to be a big problem to this observer.
What Can Be Done?

• Impose time-of-day congestion tolls on the Illinois Tollway system. An improvement in efficiency can be found, but it’s complicated.

• Improve the rail links within the metro area to reduce truck traffic.

• Maybe we should experiment with a HOT lane. Would we get more car pooling? Maybe. But where do we have enough lanes to conduct such an experiment without causing a riot?
What Can Be Done, Part 2

• Should there be a London-like cordon line around the downtown area – with a hefty fee for driving into it? Probably not because parking fees are already high, and the big problem is not traffic within the downtown area itself.

• Pour more concrete – build some version of the Crosstown Expressway. Daley I killed it by making the project too grandiose. Is it time to revisit?

• Widen the circumferential tollway? Can this be done?