Pricing-refunding in general transportation networks: when it works and how?

Yu (Marco) Nie
Northwestern University
Road pricing

• Public ownership of roads leads to efficiency loss in the form of excessive congestion
• Pricing the roads is a well-meaning yet unpopular remedy
• Pricing creates losers and winners.
  • Losers: those who are “tollled off” the road and those who pay more than they gain from congestion relief
Can we eliminate losers?

- A pricing scheme that reduces congestion at nobody’s cost? (so-called Pareto-improving)
- How about providing direct compensation using toll revenue, in the form of a lump-sum travel allowance or credit?
- The question are: under what condition we can eliminate all losers through refunding, and how revenue should be redistributed?
Some recent results

- For the case of single-OD pair and single mode, a lump-sum return would eliminate all losers if pricing reduces total travel time (Eilliasion 2000)
- For the case of multiple-OD pair and single mode: a lump-sum return would eliminate all losers if pricing reduce total travel time for each O-D pair; otherwise, cross-OD subsidization may be needed (Yang and Huang, 2005)
- For the case of multiple-OD pair and two modes (highway and transit): whether or not travel time reduction is sufficient depends on VOT distribution and the difference between the operating costs. Similar condition can be established (Liu et al., 2008, Nie and Liu 2010a, b)
Challenges and discussions

• What if we really need the money? (Design pricing-refunding scheme to maximize revenue)

• O-D specific travel time, which is often used in the design of these schemes, may NOT be unique. What is the implication? Should we force uniqueness and how?