Advancing Metropolitan Modelling for the Analysis of Urban Sustainability Policies

Modeling and optimization of multimodal urban networks with limited parking and dynamic pricing

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Comments by

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The economics of Parking

- Parking is a common property problem
  - Weitzman, 1971. Free access vs private ownership as alternative systems for managing common property, *Journal of Economic Theory* 8, 225–234.
- Pricing parking congestion
  - Glazer, A. and E. Niskanen. 1992. Parking fees and congestion. *Regional Science and Urban Economics* 22: 123-132.
- Time of use and parking
  - Arnott, de Palma, and Lindsey. 1992. A temporal and spatial equilibrium analysis of commuter parking, *Journal of Public Economics* 45: 301-335.
- Long-term impacts of parking (in relation with this conference):
  S: consider the impact of parking on (re)location

Commuter choices: nested Logit

Stage 1: mode choice. Choice between private transportation and bus.

Stage 2: Conditional of the choice of private transportation, choice between on-street parking and Garage

Externalities

- 3 types of drivers:
  - Downtown drivers
  - Drivers cruising
  - Drivers commuting
- 3 levels of negative externalities:
  - Cruising cars slow down downtown drivers (---)
  - Downtown drivers slow down downtown drivers (--)
  - Drivers commuting slow down drivers commuting (-)

Instruments and stakeholders

- Price of on-street parking $p_{oc}(t)$
- Price of garage $p_g(t)$

Q : in practice, price depend also on space x: $p_{oc}(t;x)$ and $p_g(t;x)$:
→What is the trade-off between price and distance (e.g. walked)?

Stakeholders: city (*mayor*), private operators, *residents*, commuters, *shop owners*

Instruments

- Price of on street parking $p_{oc}(t)$
- Price of garage $p_g(t)$

City operator manage on street-parking and maximize welfare.

Q : Are cities maximizing welfare?

R : In practice, city operators are in charge on some part of the city only.
Q : What does it mean to maximize welfare *locally* (and not globally)? Do nothing can be better!

Private operator manage garage and maximize profits ..“deluxe rent”.

R : Private operators may wish to manage part on the surrounding on-street parking to reduce “unfair” competition.

Regulation of parking

Without cruising:

Q : Can *the public operator attain* first-best social optimum, charging only on-street parking?

Q : Can the *private operators*, under monopolistic competition attain the social optimum, charging only on-street parking?

Q : Welfare analysis if *part of on-street parking* is managed by several private operators (queue reduce price competition)?

With cruising

Q : Same questions….

MFD (Macroscopic fundamental diagram)

- Aggregation – micro-foundation

E.g. two fluid model, as a results of microscopic statistical laws.

- Stochastic dimension away

Q : How the unstable branch of the speed flow can be taken into account in the CBA.

Dynamic assignment

- The choice at time *t* depends on the costs at time t, but should depend on the cost at time $t^a = t+tt(t)$

Suggestion: use the arrival time of previous day in the iterative procedure.

Here discrete time procedure→

S : Try analytically a continuous time model

$P_i^m\ t$: Production (mode m, time t)

$N_i^m\ t$: Vehicle accumulation (mode m, time t)

$$P_i^m\ t = G_i^m\left[N_i^m\ t \right]$$

$v_i^m\ t$: Average speed

$$v_i^m\ t = \frac{P_i^m\ t}{N_i^m\ t} = \frac{G_i^m\left[N_i^m\ t \right]}{N_i^m\ t} = \Phi\left[N_i^m\ t \right]$$ Q: Flow congestion?

Units:

$$\left[v_i^m\ t \right] = Km/h$$

$$\left[P_i^m\ t \right] = ?$$

$$\left[N_i^m \right] = ?$$

1+1=1

Proof: