Singapore’s travel demand management issues

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Acknowledgments

A Loder for the mobility tool work

L Sun for the big data analysis

FCL M8 for the SG MATSim model
A model of Singapore’s travel demand and traffic
Development of km driven per car and year (CH, 1960-)

TPP workshop
Travel, car and season-ticket ownership (CH, 1984-)

- Vehicle and season ticket
- No vehicle, but season ticket
- Vehicle, but no season ticket
- Neither

Mikrozensus Schweiz 1984
Mikrozensus Schweiz 1989
Mikrozensus Schweiz 1994
Mikrozensus Schweiz 2000

TPP workshop
Accessibility and car ownership in Switzerland
Some numbers first
Some numbers: Mode choice

- MRT, LRT, bus: 40%
- Car, motorcycle, light truck driver: 30%
- Company, school, shuttle bus: 10%
- Taxi: 0%

TPP workshop
Some numbers: Mode shares by income 2008

<table>
<thead>
<tr>
<th>Income [kSG]</th>
<th>Mode share of trips</th>
</tr>
</thead>
<tbody>
<tr>
<td>8k+</td>
<td>MRT, LRT</td>
</tr>
<tr>
<td>7k</td>
<td>Bus</td>
</tr>
<tr>
<td>6k</td>
<td>Company, school, shuttle bus</td>
</tr>
<tr>
<td>5k</td>
<td>Car, motorcycle, light truck driver</td>
</tr>
<tr>
<td>4k</td>
<td>Car, motorcycle, light truck passenger</td>
</tr>
<tr>
<td>3k</td>
<td>Taxi</td>
</tr>
<tr>
<td>2k</td>
<td></td>
</tr>
<tr>
<td>1k</td>
<td></td>
</tr>
<tr>
<td>no income</td>
<td></td>
</tr>
</tbody>
</table>
Current problems
Bus speeds in Singapore by time of day

Average travel velocity (m/s)

Time of day (h)
Bus occupancy and bus bunching during the evening peak
Headways along a bus line in Singapore

[3D graph showing headways along a bus line with axes for stop number, headway (s), and probability.]
Occupancy and MRT bunching during the morning peak
Constraints
Macroscopic fundamental diagram (Yokohama; loops)
Macroscopic fundamental diagram (Yokohama; taxis)
Analysis of the COE Category B prices since 2001

Quota

COE/Mean income

Growth rate

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What can we do?
Increase accessibility – Swiss case
Switzerland: workplace accessibility

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Switzerland: Probabilities by log of income
Switzerland: Conditional probabilities by log of income

- Pr(Ticket | Car)
- Pr(Car | Ticket)

- Pr(GA | Car)
- Pr(Car | GA)

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Fund the right mode: Downs-Thompson paradox
A simplified model of the transport market

- Generalized costs of Public transport:
  - k

- Generalized costs of Road:
  - Road now

![Graph showing the relationship between Generalized costs and Share of Road.]

TPP workshop
After building more roads: Downs-Thompson Paradox

[Graph showing the relationship between Generalized costs and Share Road for Road now and Road after, compared to Public transport.]
After improving public transport/removing road capacity

Generalized costs k - Road

Road now
Road after
Public transsport
Public transport after

Share Road
Land use: Estimated number of work places


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In summary, but for land use

TPP workshop

Number
Pop, Firm

Income
Productivity

\( \text{Acc}_{\text{car}} \)
\( \text{Acc}_{\text{bus}} \)
\( \text{Acc}_{\text{rail}} \)

\( n_{\text{car}} \)
\( n_{\text{GA}} \)

\( q_{\text{car}} \)
\( q_{\text{bus}} \)
\( q_{\text{rail}} \)

3D MFD

\( v_{\text{car}} \)
\( v_{\text{bus}} \)
\( v_{\text{rail}} \)

\%cap_{\text{car}}
\%cap_{\text{bus}}
\%cap_{\text{rail}}

Exogenously given

Technical relationships

Free variables

Positive elasticity

Negative elasticity

\( \text{tax}_{\text{income}} \)

\( \text{tax}_{\text{car}} \)

\( \text{tax}_{\text{GA}} \)

\( \text{fee}_{\text{car}} \)

\( \text{fee}_{\text{PT}} \)

\( \text{budget}_{\text{transport}} \)
Questions?

www.matsim.org
www.ivt.ethz.ch
www.futurecities.ethz.ch
www.senozon.ch
<table>
<thead>
<tr>
<th></th>
<th>Season-ticket owner</th>
<th>Car available</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age</td>
<td>-0.059 ***</td>
<td>0.099 ***</td>
</tr>
<tr>
<td>Age squared</td>
<td>0.052 ***</td>
<td>-0.088 ***</td>
</tr>
<tr>
<td>Male</td>
<td>-0.132 ***</td>
<td>0.439 ***</td>
</tr>
<tr>
<td>Working</td>
<td>0.066 ***</td>
<td>0.258 ***</td>
</tr>
<tr>
<td>University level education</td>
<td>0.146 ***</td>
<td>-0.054 **</td>
</tr>
<tr>
<td>Log of monthly household income</td>
<td>0.075 ***</td>
<td>0.391 ***</td>
</tr>
<tr>
<td>Center of agglomeration</td>
<td>0.132 ***</td>
<td>-0.22 ***</td>
</tr>
<tr>
<td>Constant</td>
<td>0.052</td>
<td>-6.039 ***</td>
</tr>
<tr>
<td></td>
<td>Season-ticket owner</td>
<td>Car available</td>
</tr>
<tr>
<td>------------------------</td>
<td>---------------------</td>
<td>---------------</td>
</tr>
<tr>
<td>Local access to public transport: E</td>
<td>-0.474 ***</td>
<td>0.505 ***</td>
</tr>
<tr>
<td>Local access to public transport: D</td>
<td>-0.348 ***</td>
<td>0.384 ***</td>
</tr>
<tr>
<td>Local access to public transport: C</td>
<td>-0.253 ***</td>
<td>0.286 ***</td>
</tr>
<tr>
<td>Local access to public transport: B</td>
<td>-0.097 ***</td>
<td>0.154 ***</td>
</tr>
<tr>
<td>General accessibility</td>
<td>0.089 ***</td>
<td>-0.028 ***</td>
</tr>
<tr>
<td>Surplus public transport acc.</td>
<td>-0.005 ***</td>
<td>-0.066 ***</td>
</tr>
<tr>
<td>Surplus workplace accessibility</td>
<td>0.729 ***</td>
<td>-0.527 ***</td>
</tr>
</tbody>
</table>

TPP workshop
## Switzerland: GA given season ticket (2/2)

<table>
<thead>
<tr>
<th></th>
<th>General abonnement</th>
</tr>
</thead>
<tbody>
<tr>
<td>Secondary residence</td>
<td>0.302</td>
</tr>
<tr>
<td>Log of monthly household income</td>
<td>0.128</td>
</tr>
<tr>
<td>Self-reported distance [1000km]</td>
<td>0.005</td>
</tr>
<tr>
<td>Constant</td>
<td>-2.188</td>
</tr>
</tbody>
</table>

### Error correlations

<table>
<thead>
<tr>
<th></th>
<th>Car available</th>
<th>GA</th>
</tr>
</thead>
<tbody>
<tr>
<td>Season ticket</td>
<td>-0.44</td>
<td>0.62</td>
</tr>
<tr>
<td>Car available</td>
<td>-0.24</td>
<td></td>
</tr>
</tbody>
</table>