How many cars are too many? A first attempt

KW Axhausen

IVT
ETH
Zürich

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Acknowledgments

V Killer for the analysis of the Swiss labour market areas

A Loder for the mobility tool ownership work

A Loder and R Tanner for work/homes balance

L Sun for the big data analysis

FCL M8 for the SG MATSim model
Constraints
Macroscopic fundamental diagram (Yokohama; loops)
Desires
Quality- and inflation adjusted car prices

Source: nach Frei (2005)

Frei, 2004
Raff und Trajtenberg, 1990
Development of km driven per car and year (CH, 1960-)

Annual kilometers per car vs. Cars per 1000 Adults (20 years and over)
Singapore everywhere?
Some numbers first
Some SG numbers: Mode shares by income 2008

Income [kSG]

- 8k+
- 7k
- 6k
- 5k
- 4k
- 3k
- 2k
- 1k
- no income

Mode share of trips

- MRT, LRT
- Bus
- Company, school, shuttle bus
- Car, motorcycle, light truck driver
- Car, motorcycle, light truck passenger
- Taxi
Current problems in Singapore
Bus speeds in Singapore by time of day
Headways along a bus line in Singapore
Occupancy and MRT bunching during the morning peak
A model of Singapore’s travel demand and traffic
Would this be enough?
What can we do?
Control car ownership: Singapore
Analysis of the COE Category B prices 2001 - 2013

Growth rate

Quota

COE/Mean income

Growth rate

.50
1.50
3.00
Increase transit accessibility: Swiss case
Travel, car and season-ticket ownership (CH, 1984-2000)

- 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

Trips with motorized vehicles/day vs. Public transport trips/day
Accessibility and car ownership in Switzerland
Switzerland: general accessibility
Switzerland: Probabilities by log of income

- Pr(Car)
- Pr(Ticket)
- Pr(GA)

- Pr(Ticket & Car)
- Pr(None)
- Pr(GA | Car)
- Pr(Car | Ticket)
Switzerland: Conditional probabilities by log of income

- $\text{Pr(Ticket | Car)}$
- $\text{Pr(Car | Ticket)}$
- $\text{Pr(GA | Car)}$
- $\text{Pr(Car | GA)}$

Probability vs. log of monthly household income
Switzerland: Probabilities by general accessibility
Fund the right mode: Downs-Thompson paradox
A simplified model of the transport market

![Graph showing the relationship between Generalized costs and Share Road for Road now and Public transport. The graph indicates that as the share of road decreases, the generalized costs increase significantly for Road now, while Public transport shows a more gradual increase.]
After building more roads: Downs-Thompson Paradox

Generalized costs - Road

- Road now
- Road after
- Public transport

Generalized costs - Public transport

Share Road

0% 25% 50% 75% 100%

0.0 2.5 5.0 7.5 10.0 12.5 15.0
After improving public transport/removing road capacity

**Generalized costs $k\cdot\text{Road}**

- **Road now**
- **Road after**
- **Public transport**
- **Public transport after**
Place people and work right
Place people and work right: Work/homes balance
Further research questions
Further research questions

- What shapes the mMFD for a given demand?
  - Lane miles
  - Share of joint road space
  - Junction forms/number of conflict points
  - Network form

- Balance between fixed and variable costs for roads and transit

- Impact of parking provision and pricing

- Impact and likelihood of electric autonomous fleets

- Urban form: Functionality and livability
Questions?
Appendix
<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>
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<tr>
<td>University level education</td>
<td>0.146 ***</td>
<td>-0.054 **</td>
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<tr>
<td>Log of monthly household income</td>
<td>0.075 ***</td>
<td>0.391 ***</td>
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<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>
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</tbody>
</table>
### Switzerland: Ownership models (2/2)

<table>
<thead>
<tr>
<th></th>
<th>Season-ticket owner</th>
<th>Car available</th>
</tr>
</thead>
<tbody>
<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>
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</table>
### Switzerland: GA given season ticket (2/2)

<table>
<thead>
<tr>
<th></th>
<th>General abonnement</th>
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<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>
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<tr>
<td>Constant</td>
<td>-2.188 ***</td>
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### Error correlations

<table>
<thead>
<tr>
<th></th>
<th>Car available</th>
<th>GA</th>
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</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>
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