Changes in Swiss Accessibility Since 1850

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Questions

- Why bother with accessibilities?
- What are the trends for Switzerland?
The mistaken logic of public capital

The literature since Aschauer (1989) assumes:

\[ \Delta y(t) = f(\Delta p(t), \Delta x(it)) \]

with

\[ \Delta y(t) : \text{GNP, productivity change} \]
\[ \Delta p(t) : \text{Road or other transport capital change} \]
\[ \Delta x(it) : \text{Change in other relevant variables} \]
Does this work?

Implicit assumption:

\[ \Delta p(t) \sim \Delta \text{Network services}(t) \]

but this implies constant proportionalities for each of the following:

\[ \Delta p(t) \sim \Delta \text{Lane miles}(t) \]
\[ \Delta \text{Lane miles}(t) \sim \Delta \text{Capacity}(t) \]
\[ \Delta \text{Capacity}(t) \sim \Delta \text{Speed}(t) \]
\[ \Delta \text{Speed}(t) \sim \Delta \text{Accessibility}(t) \]
\[ \Delta \text{Accessibility}(t) \sim \Delta \text{Network services}(t) \]
Switzerland: Changing costs of one km motorway

Kumulative Länge [%]

Kumulative Investitionen [%]

Switzerland: Changing speed gain of capacity expansion

Two-lane motorways

Trunk roads

Axhausen und Fröhlich, 2004
Size of goods markets and productivity: A hypothesis

Economies of scale
Economies of scope

Activity
Tours

GDP
Fleet comfort
slots
vtts et al.
vkm
Energy costs

For a given infrastructure and commercial and private fleet

Elasticity > 0
Elasticity < 0

Slots: possibilities to move goods or people
Accessibility as the log-sum term of a choice model

In line with the literature we use:

\[ Acc_i = \ln \sum_{\forall j} X_j e^{-\beta c_{ij}} \]

Using:
- Weighting parameter ($\beta$) of 0.2
- Travel time as the only generalised cost element ($c_{ij}$)
- Population as number of opportunities ($X_j$)
**Description of Elements: Overview**

<table>
<thead>
<tr>
<th>Study area:</th>
<th>Switzerland and surrounding jurisdictions in a 350 km band</th>
</tr>
</thead>
<tbody>
<tr>
<td>Spatial resolution:</td>
<td>Municipality equals one zone/Bezirk</td>
</tr>
<tr>
<td></td>
<td>Larger municipalities are subdivided</td>
</tr>
<tr>
<td></td>
<td>Zones outside Switzerland on regional or county level</td>
</tr>
<tr>
<td>Intrazonal travel times:</td>
<td>Dependent on equivalent radius of the size of the built up area</td>
</tr>
</tbody>
</table>
Description of Elements: Road transport

Network resolution: All major road developments inside Switzerland and motorway development outside

Link description: Assumed mean speeds by 51 link types based on a detailed historical review

Centroid connectors: Fixed speeds

Travel time calculation: Shortest-time paths
Description of Elements: Public transport

Timetables: Detailed time tables for all regular interurban trains (without S-Bahn) Coaches and interurban buses, where relevant

Station connectors: Fixed speeds

Travel time calculation: Shortest-time paths (including transfer times)
Description of Elements: Years

Matching the census the reference areas are:

- 1850, 1888, 1910, 1930 Only Bezirke
- 1950 and then each decade Municipalities and Bezirke
### Road network models

<table>
<thead>
<tr>
<th>Year</th>
<th>mod. Links CH</th>
<th>Total CH Links CH</th>
<th>mod. Links EU</th>
<th>Total Links EU</th>
</tr>
</thead>
<tbody>
<tr>
<td>1950</td>
<td>3'527</td>
<td>17'698</td>
<td>136</td>
<td>29'248</td>
</tr>
<tr>
<td>1960</td>
<td>3'589</td>
<td>17'760</td>
<td>195</td>
<td>29'307</td>
</tr>
<tr>
<td>1970</td>
<td>4'147</td>
<td>18'318</td>
<td>422</td>
<td>29'534</td>
</tr>
<tr>
<td>1980</td>
<td>4'810</td>
<td>18'981</td>
<td>747</td>
<td>29'859</td>
</tr>
<tr>
<td>1990</td>
<td>5'215</td>
<td>19'386</td>
<td>896</td>
<td>30'008</td>
</tr>
<tr>
<td>2000</td>
<td>-</td>
<td>19'700</td>
<td>-</td>
<td>30'053</td>
</tr>
</tbody>
</table>
Road travel times from Zürich (1850)
Public transport travel times from Lausanne (1850)
Road travel times from Zürich (2000)
Public transport travel times from Lausanne (2000)
Road travel time-scaled map of Switzerland 1950

Scherer, 2004
Road travel time-scaled map of Switzerland 2000
Rail travel time-scaled map of Switzerland 1950
Rail travel time-scaled map of Switzerland 2000
Accessibilities of the Bezirke since 1850
Road based accessibilities 1950 (without log)
Road based accessibilities 1960 (without log)
Road based accessibilities 1970 (without log)
Road based accessibilities 1980 (without log)
Road based accessibilities 1990 (without log)
Road based accessibilities 2000 (without log)
Growth of the road based accessibilities 1950 to 2000
Ratio of road to public transport accessibilities 2000
Conclusions

Tracking the road-based accessibility changes is possible over a long period of time.

It seems advisable to concentrate only on the developments of the motorways and similar high capacity roads.

Public transport requires full timetables.

Public transport accessibilities underestimated due to the omissions of schedule delay effects (headways)
Conclusions

Need to track not only infrastructure, but also regulations and the vehicle fleet.

Policy impetus to the equalisation of speeds

Winners are the suburban municipalities between the major centres

Saturation effects visible
Literature


Appendix
### Mean ratios of road to public transport accessibility

<table>
<thead>
<tr>
<th></th>
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</tr>
</thead>
<tbody>
<tr>
<td>Mean</td>
<td>1.31</td>
<td>1.33</td>
<td>1.38</td>
<td>1.38</td>
<td>1.37</td>
<td>1.36</td>
</tr>
<tr>
<td>Median</td>
<td>1.28</td>
<td>1.30</td>
<td>1.33</td>
<td>1.33</td>
<td>1.32</td>
<td>1.32</td>
</tr>
<tr>
<td>Std. Dev.</td>
<td>0.19</td>
<td>0.21</td>
<td>0.23</td>
<td>0.24</td>
<td>0.23</td>
<td>0.22</td>
</tr>
<tr>
<td>25% percentil</td>
<td>1.16</td>
<td>1.17</td>
<td>1.19</td>
<td>1.19</td>
<td>1.19</td>
<td>1.19</td>
</tr>
<tr>
<td>75% percentil</td>
<td>1.43</td>
<td>1.46</td>
<td>1.53</td>
<td>1.53</td>
<td>1.51</td>
<td>1.50</td>
</tr>
</tbody>
</table>

Based on municipal accessibilities, with their own-accessibility included.