Large Scale Accessibility Study: Which level of accuracy is necessary?

Ph Fröhlich and KW Axhausen

IVT
ETH
Zürich

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Motivation: The mistaken logic of public capital

The literature since Aschauer (1989) assumes:

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

with

- \( \Delta y(t) \) : GNP, productivity change
- \( \Delta p(t) \) : Road or other transport capital change
- \( \Delta x(it) \) : 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:

\[ \Delta p(t) \sim \Delta \text{Lane miles}(t) \]
\[ \Delta \text{Lane miles}(t) \sim \Delta \text{Capacity}(t) \]
\[ \Delta \text{Capacity}(t) \sim \Delta \text{Speed}(t) \]
\[ \Delta \text{Speed}(t) \sim \Delta \text{Accessibility}(t) \]
\[ \Delta \text{Accessibility}(t) \sim \Delta \text{Network services}(t) \]
Approach

Tracking the road and public transport-based accessibility changes in Switzerland from 1950 to 2000 in 10 year steps.

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

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 (1)

<table>
<thead>
<tr>
<th>Study area:</th>
<th>Switzerland and surrounding jurisdictions in a 350 km band</th>
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</thead>
<tbody>
<tr>
<td>Spatial resolution:</td>
<td>Municipality equals one zone</td>
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<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>Network resolution:</td>
<td>All major road developments inside Switzerland and motorway development outside</td>
</tr>
</tbody>
</table>
Description of Elements (2)

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

Intrazonal travel times: Dependent on equivalent radius of the size of the built up area

Centroid connectors: Fixed speeds

Travel time calculation: Time-shortest paths
# Road network models

<table>
<thead>
<tr>
<th>Year</th>
<th>mod. Links CH</th>
<th>Total 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>
Development of average speeds on Swiss roads

Two-lane motorways

Trunk roads
Road-based accessibility 1950 and 2000

1950

2000
Ratio of road-based accessibility 2000 to 1950

Parameters: Min = 0.22; - 0.5 Std. Deviation = 1.47; Mean = 1.97; + 0.5 Std. Deviation = 2.47; Max = 24.29)
Ratio road to public transport-based accessibility 2000

Parameters: Min = 0.069; - 0.5 Std. Deviation = 2.14; Mean=4.99; + 0.5 Std. Deviation = 7.857; Max = 70.55
Ration of road-based accessibility UE to M2 for 2000

Parameters: Min = 0.64; - 0.5 Std. Deviation = 1.64; Mean=1.97;
+ 0.5 Std. Deviation = 2.31; Max = 7.375
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.

A population of 70'000 seems to be a reasonable maximum for a zone.

Public transport results require a full time table.
Literature


Network length and cumulative inflation-corrected costs of the Swiss federal road network

Investment [%]

Cumulative length and expenditure of federally funded roads