Accessibility and spatial development: The case of Switzerland between 1950 and 2000

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What is accessibility?

Any number of definitions, but the basic types are:

- Existence of link of a given quality
- Number of opportunities reachable within a certain cost isoline
- Cost-weighted number of opportunities
Accessibility as *Potential*

Form:

\[ A_i = \ln \left( \sum_{k_{ij}=0}^{c_{ij} < c_{\text{max}}} X_j f( c_{ij} ) \right) \]

with:

- \( A(i) \): Accessibility of location \( i \)
- \( c(ij) \): Generalised cost of movement from \( i \) to \( j \)
- \( X(j) \): Opportunities of interest at location \( j \)
- \( f[c(ij)] \): Weighting function of the generalised costs
Accessibility as *Potential*

Theoretical justification

- $A(i)$ is the log sum term of a simple destination choice model with $\ln X$ and sum measure of generalised costs
- $c(ij)$ could be inclusive term of a mode choice model

Normal application

- $c(ij) \sim$ travel time
- $f[c(ij)]$ is a negative exponential with a chosen $b$, so that $f[c(ij)] = \exp[-b \cdot c(ij)]$
- $c(max)$ is equal to infinity
Why are we interested in accessibility?

Mechanisms:

- Accessibility ~ 1/Generalised costs ~ Speed
- Accessibility ~ Market size

What should follow from this:

- Benefits from trade (specialisation, economies of scale)
- Better fit between supply and demand (goods and labour markets)
- More reliability and range in services and supplies
- but, the winning region is unclear!
Accessibility change and economic growth

Previous work:
- Aschauer (1989) and others: large spatial units, short durations (10-15 years), public capital instead of accessibility
- Most authors argue: Massive early impacts, little further impacts expected

Aims of our work:
- Small spatial units (2900 municipalities)
- Long duration (50 years)
- Accessibility (detailed road and rail networks)
- Calibrated cost parameters (mode choice model)
- Population, employment, value added as Y’s
Confounding factors: Population growth

![Graph showing the resident population growth over years.]

- The x-axis represents the years from 1950 to 2000.
- The y-axis represents the resident population in millions [Mio].
- The population shows a slight increase over the years.
Confounding factors: GDP growth
Railway isochrones (Zürich, 1960, 8 to 9 am)

Longer distance services only!
Railway isochrones (Zürich, 1980, 8 to 9 am)

Longer distance services only!
Railway isochrones (Zürich, 2000, 8 to 9 am)

Longer distance services only!
Motorway network 1950
Motorway network 1980
Motorway network 2000
Development of the trunk road networks (1950-2000)
Initial accessibility estimates

Networks

• Do not include all trunk roads built
• Initial mean speed estimates (no assignment)

Opportunities

• Population only
• Arbitrary, but reasonable consideration of own-potentials
• b is a reasonable guess
Road based accessibility (1950) (Switzerland only)
Road based accessibility (1960) (Switzerland only)
Road based accessibility (1970) (Switzerland only)
Road based accessibility (1980) (Switzerland only)
Road based accessibility (1990) (Switzerland only)
Road based accessibility (2000) (Switzerland only)
Confounding factors: Air traffic (technology, services)

Index (2000 = 100)

- Number of flights (Factor 14)
- Scheduled flying time (Factor 3)
- Cheapest official return fare (Factor 17)
Accessibility by air services (1950) (only abroad)
Accessibility by air services (1950) (only abroad)
Modelling issues

- Causality between network growth and population/economic growth
- Spatial and temporal correlations
- Panel with few cross sections, but many units
- Simultaneous changes:
  - Networks and services
  - Restructuring of employment
  - Deindustrialisation/service growth (international competition)
  - Population growth
  - Real income growth (suburbanisation, motorisation)
  - Subsidies as confounding factors
Responses: Commute shed (Zürich, 1970)
Responses: Commute shed (Zürich, 2000)
Responses: Density kernel estimates (Zürich, 1970)
Responses: Density kernel estimates (Zürich, 2000)
Response: „Zwischenstadt“, European suburbia

Population growth between Geneva and St. Gall since 1870
Response: Accessibility and population change
Link between investment and accessibility change

By canton!
Some too simple regressions (by canton and decade)

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What next?

Networks:

- Improved mean speed estimates
- Fully contemporaneous networks
- All railway services
- Assigned speed (≈ demand estimates by municipality)

Parameters

- Specific beta’s
- Generalised cost parameters (road, rail)
What next?

Modelling:

• Appropriate panel models for
  • population growth
  • economic growth

• Accounting for spatial correlations

• Accounting for international competition


