Preferred citation style

Shrinking worlds and expanding social networks: Travel impacts of structural change

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IVT
ETH
Zürich

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Trends: Road travel time scaled Switzerland (1950 & 2000)

Scherer, 2004
Trends: Real revenues per mile (USA since 1880)
Trends: Quality controlled prices of the mean new Swiss car

![Graph showing the quality-controlled price index of new Swiss cars from 1900 to 2010.](graph.png)

- **Qualitätsbereinigter Preisindex (2004 = 100) [%]**
- **Jahr**

- Frei, 2004
- Raff und Trajtenberg, 1990
Trends: Real price of telecommunication

Adapted from FCC (2001)

US International and interstate average revenue per minute
Response: Increasing trip length (Germany since 1976)
Response: Swiss car availability since 1984
Response: Swiss Suburbanisation since 1970

Adapted from Botte, 2003
Response: Annual vmt increase since 1960

Source: Schäfer
How to model the shrinking world?

- Network models
- Accessibility
- Time-scaled maps
Alternative approach

Tracking the road and public transport-based accessibility changes in Switzerland from 1850.

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

Using:
- Weighting parameter (\(\beta\)) of 0.2
- Travel time as the only generalised cost element (\(c_{ij}\))
- Population as number of opportunities (\(X_j\))
Switzerland: Changing speeds

Two-lane motorways

Trunk roads
Accessibilities of the Bezirke since 1850

Jahr

Fremderreichbarkeit MIV
Fremderreichbarkeit ÖV
Absolut accessibilities (road) (1950)
Absolut accessibilities (road) (2000)
Absolut accessibilities (public transport) (1950)
Absolut accessibilities (public transport) (2000)
Public transport - time scaled Switzerland (1950 & 2000)
Aside: Construction of the time-scaled maps

Three stage procedure:

- Selection of relevant locations
- Rescaling using the OLS criteria
- Adding further points
- Rescaling using the OLS criteria
- Smoothing all other points using the known rescalings
- „Rubbersheet“ the map using the dense set of rescalings
Kilometers travelled by purpose [%]

<table>
<thead>
<tr>
<th></th>
<th></th>
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<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Leisure</td>
<td>44.8</td>
<td>38.3</td>
<td>33.7</td>
<td>32.2</td>
</tr>
<tr>
<td>Work and school</td>
<td>35.0</td>
<td>29.7</td>
<td>32.0</td>
<td>31.3</td>
</tr>
<tr>
<td>Shopping/Private business</td>
<td>11.2</td>
<td>21.7</td>
<td>19.7</td>
<td>27.6</td>
</tr>
<tr>
<td>Accompanying</td>
<td>4.9</td>
<td>4.5</td>
<td>7.6</td>
<td>8.5</td>
</tr>
<tr>
<td>Other</td>
<td>1.8</td>
<td>4.8</td>
<td>7.1</td>
<td>0.5</td>
</tr>
</tbody>
</table>
The social content of travel (2003 Thurgau)

- Short vacation
- Excursion: nature
- Other
- Excursion: culture
- Meeting friends
- Further education (leisure)
- Garden/cottage
- Voluntary work
- Disco, pub, restaurant, cinema
- Meeting relatives/family
- Window shopping
- Pick up/drop off/attendance
- Group/club meeting
- Family duty
- Cemetery
- Active sports
- Education
- Long-term shopping
- Walk or stroll
- Daily shopping
- Private business
- Private business (doctor,...)
- Work
- Household members travelling along
- Other persons travelling along
- Dog travelling along
The „network actor“ in a dynamic social context

- Personal worlds of others
- Social capital: stock of joint abilities, shared histories and commitments
- Personal world
- Biography
- Learning
- Projects
- Household locations
  - Social network geography
  - Mobility tools

23
Spatial and social density

- Dense/tight
- Dense/loose
- Sparse/tight
- Sparse/loose
Activity spaces & network geographies: A partial hypothesis

- Wages
  - Fleet comfort
  - Housing consumption
  - vtt's et al.
  - Energy costs

- Activities
  - Tours
  - pkm
  - vkm

- Specialisation
  - Migration

- Professional and personal activity space
  - Number of networks
    - Network overlap
      - Local anomie

- Elasticity: > 0, < 0
Willingness to pay for reduction of free-flow travel time
Willingness to pay for reduction of congested travel time

Axhausen, Hess, König, Bierlaire, Bates and Abay, 2006
Dynamics of the goods/services markets: A partial hypothesis

Economies of scale
Economies of scope

Activity
Tours
t/pkm

GDP
Fleet comfort
slots
vkm

Market size

Energy costs

Elasticity > 0 Slots: possibilities to move goods or people
Elasticity < 0 For a given infrastructure and commercial and private fleet
Objects of interest (cross section)

- Name, type and membership of the networks (groups)
- Name and type of the contacts (strength of the link)

- Home location of the contacts
- Places, dates and duration of meetings with the networks (or subsets)
  - Role, cost and cost allocation of the meeting
  - Cost, cost allocation and duration of associated trip

- Channel, dates, size of other interactions with the contacts
  - Cost of interaction and its allocation
  - Location of the persons during the interaction
Objects of interest (panel/retrospective)

• Mobility biography:
  • Home locations
  • Work/school locations
  • Mobility tools (car, season tickets, cycles, licences)
  • Income
  • Household structure

• All of the cross-sectional items across time
Current work

(BMW) ifmo:
- 30 interviewees in Berlin and Zürich
- Quota-guided recruitment
- 2.5h duration
- £ 50 incentive

Dft Horizons (with Urry and Larsen, Lancaster):
- 24 interviewees drawn from three growing industries in the North-West of England
- 2h duration plus written elements
- £ 50 incentive
How to measure the activity spaces & SNGs

Parametric:
  • 95% confidence ellipse

Semiparametric:
  • Kernel density estimator
  • Inclusion geometries
  • Shortest path networks

Non-parametric
  • Observed path geometries
Example of a social network geography

Female, 28, 4 moves,
More examples
Distribution of the social network geographies (95% CE)

Both samples
Distribution of the interpersonal distances (Horizon)
Channels of communication by distance (Horizon)

![Graph showing the number of contacts per year for different communication channels (Face-to-Face, Phone, Email, SMS) as a function of the median of the quintiles of the distance distribution in kilometers.](image)

Legend:
- Black: Face-to-Face
- Blue: Phone
- Red: Email
- Cyan: SMS

The graph illustrates how the number of contacts decreases as the distance increases, with Face-to-Face being the most frequent communication method up to a certain distance, followed by Phone and then Email and SMS.
What next?

Methodological questions:

• Has the shrinkage been as large elsewhere?

• How can we measure the social network geography?
• Has the stipulated increase in the social network geographies happened?

• Is localised anomie real?
• How costly is it?
What next?

Policy questions:

• How important is localised anomie relative to the other externalities of transport?

• Can we devise (transport) policies to address it?

• Should we address?

• What are the (cross)-elasticities between the modes of contact?
Appendix
## 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

<table>
<thead>
<tr>
<th>Element</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Timetables</td>
<td>Detailed time tables for all regular interurban trains (without S-Bahn)</td>
</tr>
<tr>
<td></td>
<td>Coaches and interurban buses, where relevant</td>
</tr>
<tr>
<td>Station connectors</td>
<td>Fixed speeds</td>
</tr>
<tr>
<td>Travel time calculation</td>
<td>Shortest-time paths (including transfer times)</td>
</tr>
</tbody>
</table>
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>
Measurement approaches: Confidence ellipse

Home

University
Measurement approaches: Kernel densities

Workplace

Main shopping locations
Measurement approaches: Inclusion geometries

Find:

$$\min A_i(\beta_1 \ldots \beta_n)$$

s.t.

Area $A_i$ covering $p\%$ of all observed points

with:

- $i$ : Type of geometry (Ellipse, bean, Cassini ...)
- $p$ : Predetermined share, e.g. 95\%
Measurement approaches: Inclusion geometries

- Ellipse
- Superellipse 1
- Superellipse 2
- Bean
- Cassini

Vaze, Schönfelder and Axhausen, 2005
Measurement approaches: Shortest path network
Size of goods markets and productivity: A hypothesis

+ Elastizität > 0  k: Generalisierte
- Elastizität < 0  Kosten
Generalised costs of contact and social networks

Message costs

- k

- Number of contacts and networks

- Left skew of intensity distribution

+ Elasticity > 0

- Elasticity < 0

Migration

Professional activity space

- Network geography

- Supervision gradient

Personal activity space

- Network overlap

- Local anomie

+ Elasticity > 0

- Elasticity < 0


