Preferred citation style

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

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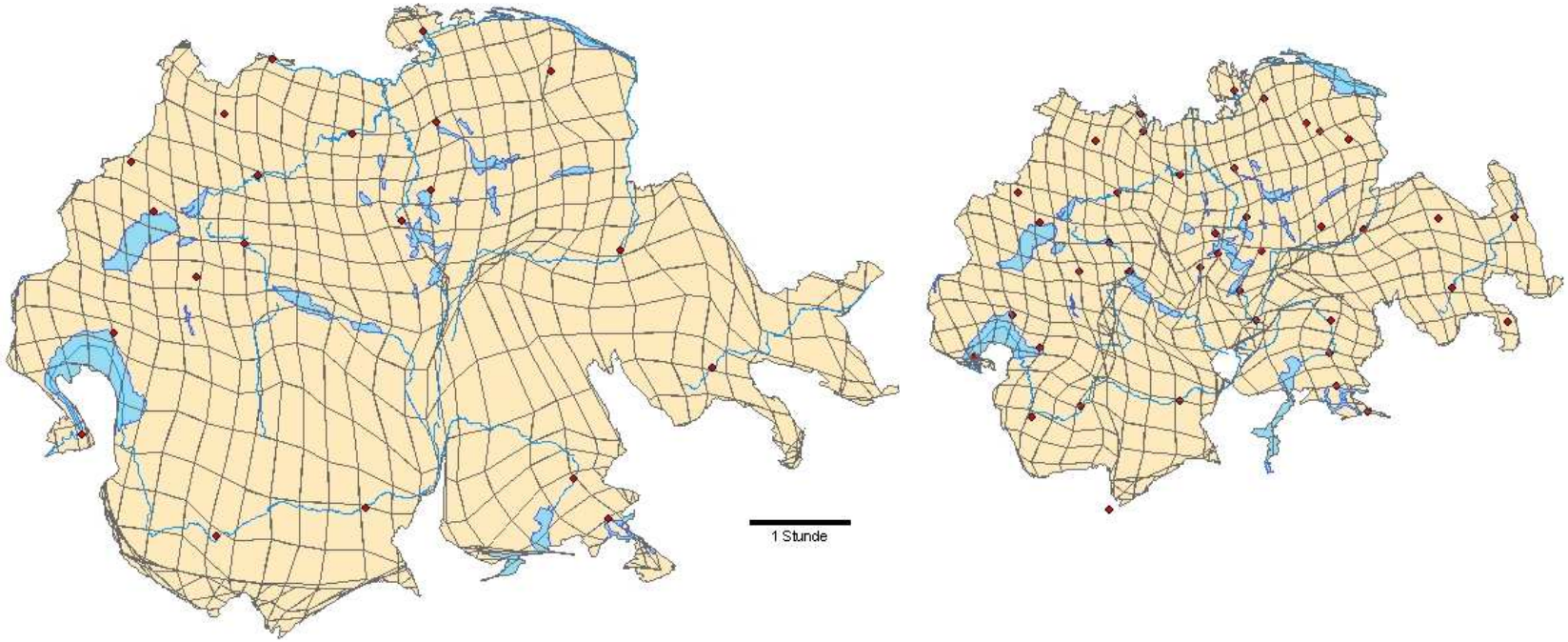
Institute for Transport Planning and Systems

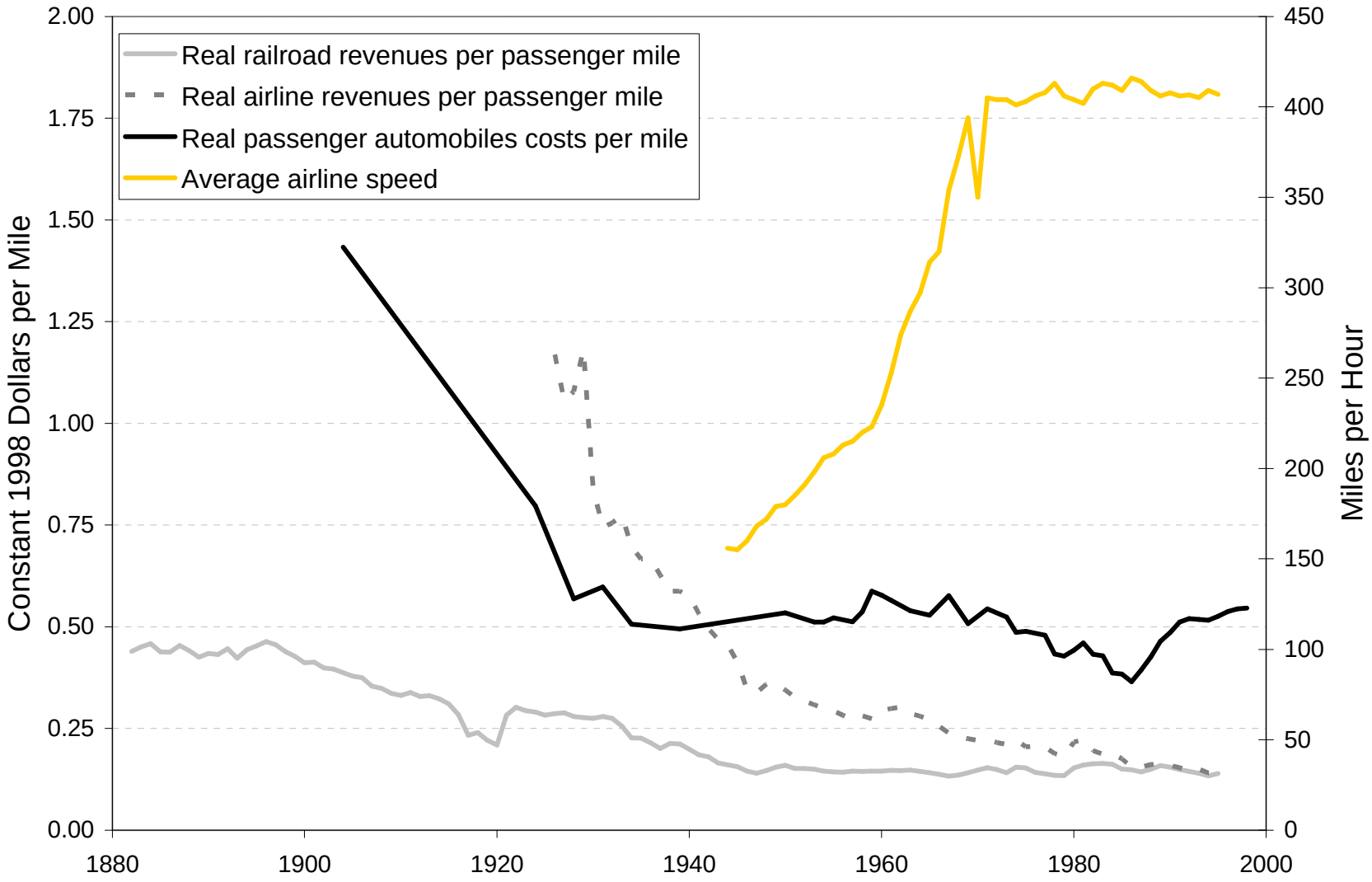
ETH
Eidgenössische Technische Hochschule Zürich
Swiss Federal Institute of Technology Zurich

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

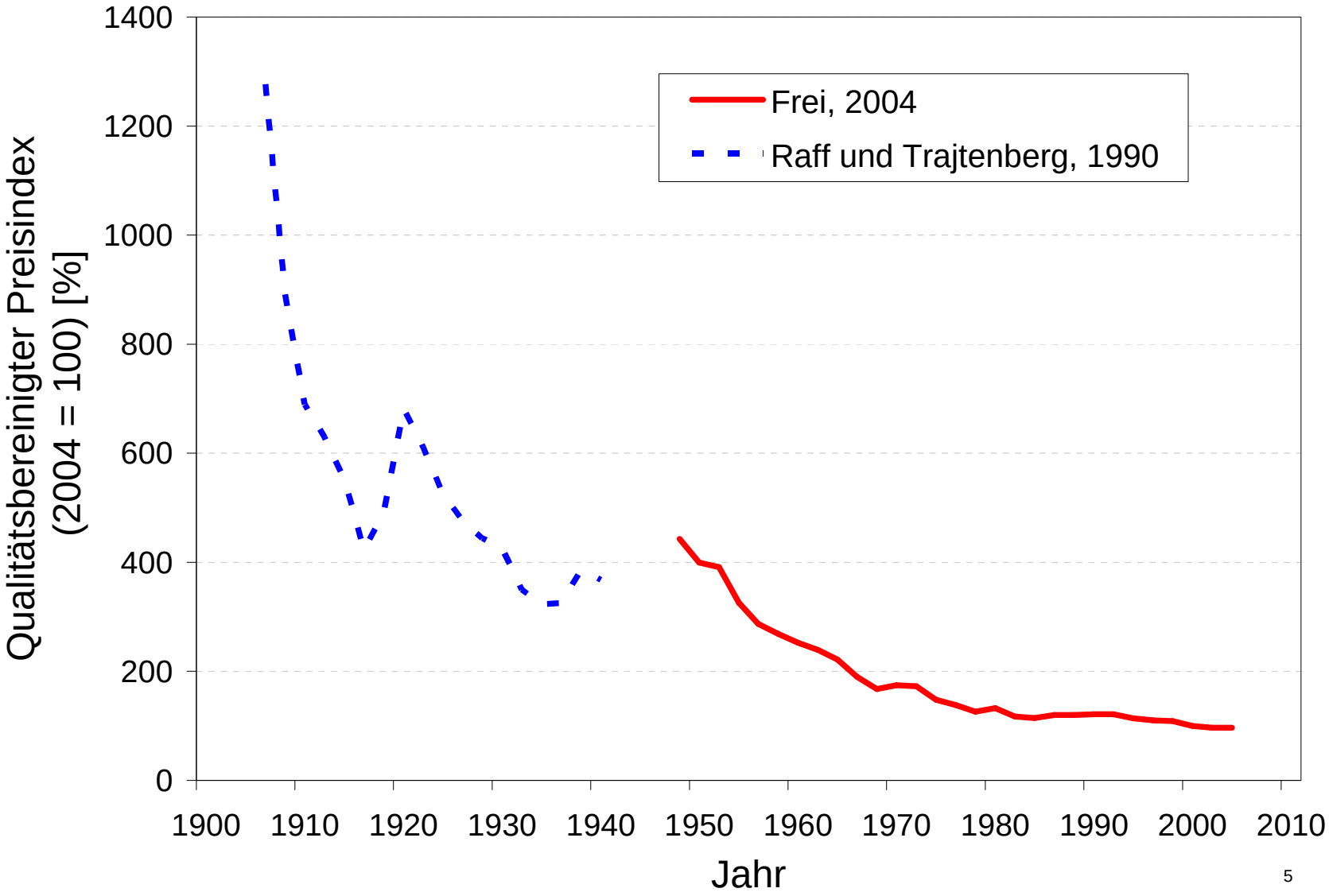


Scherer, 2004

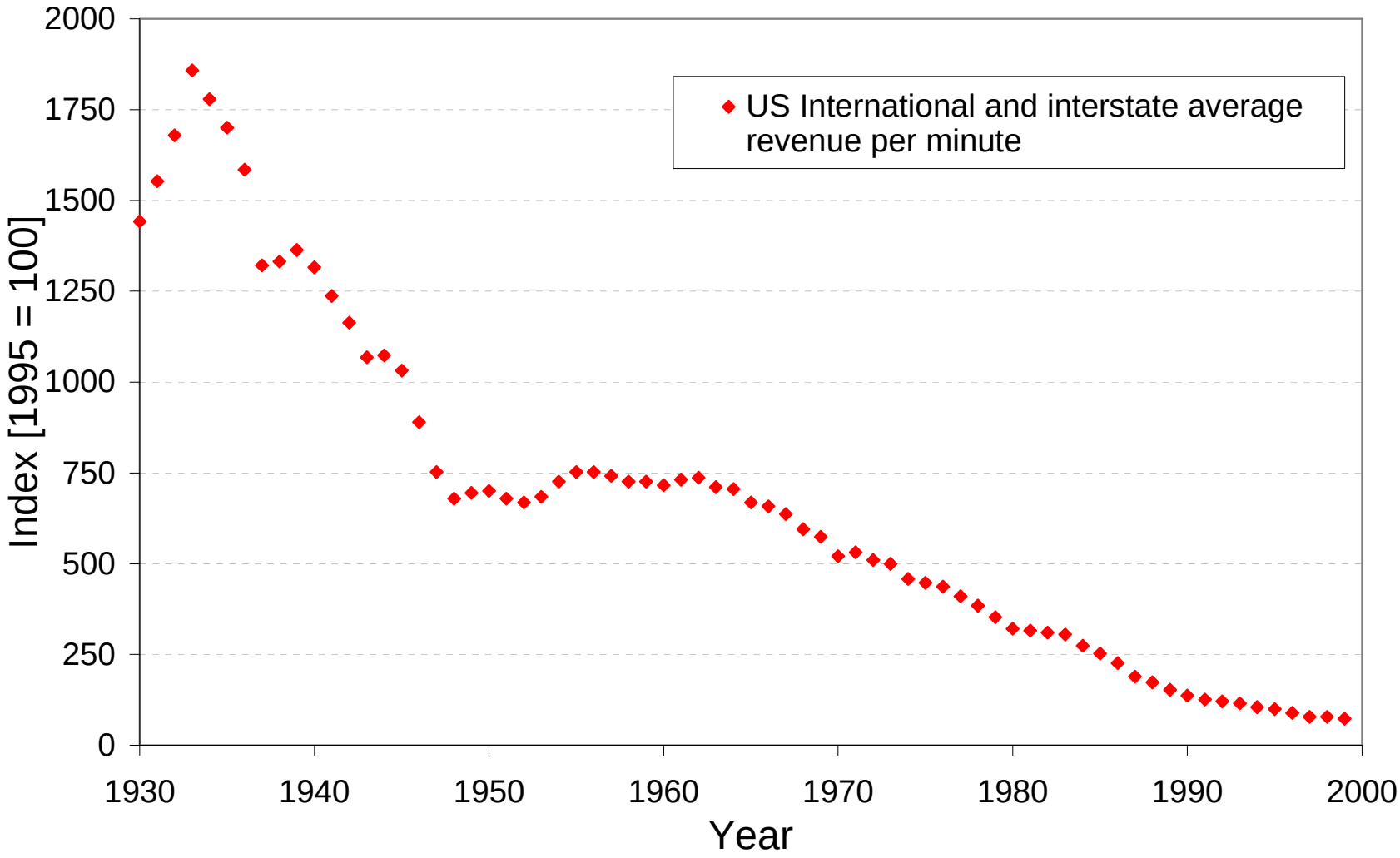
Trends: Real revenues per mile (USA since 1880)



Trends: Quality controlled prices of the mean new Swiss car

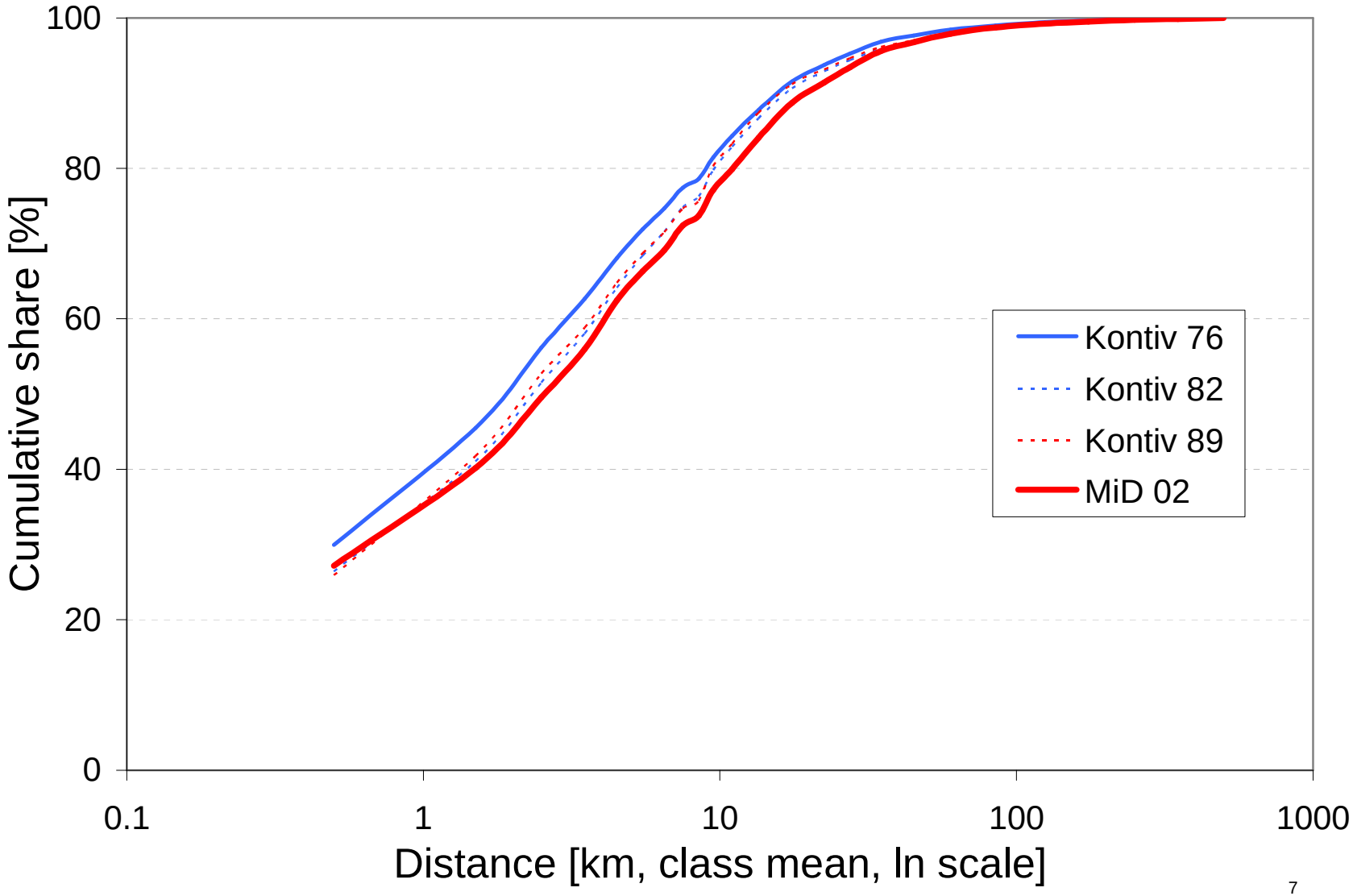


Trends: Real price of telecommunication

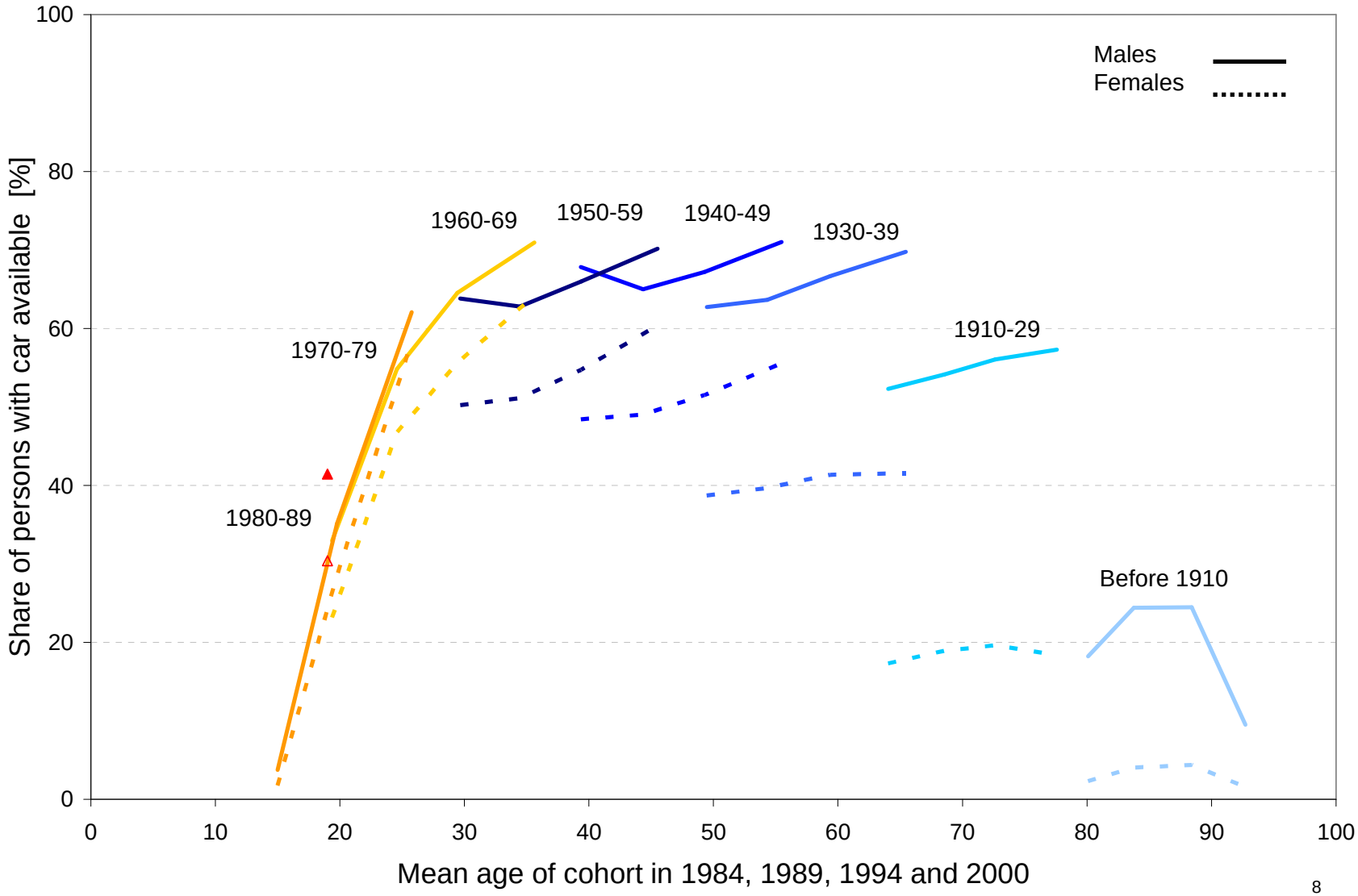


Adapted from FCC (2001)

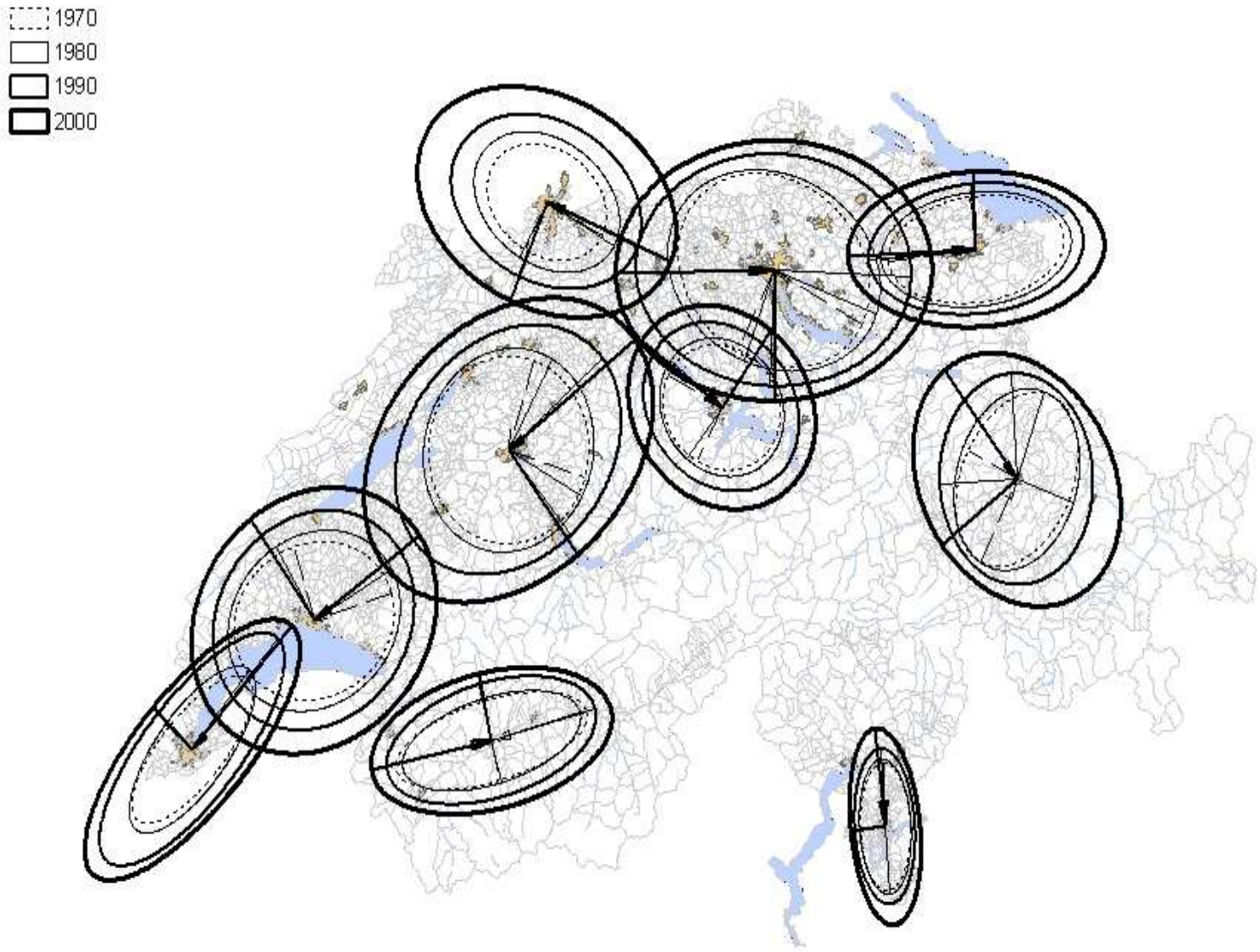
Response: Increasing trip length (Germany since 1976)



Response: Swiss car availability since 1984

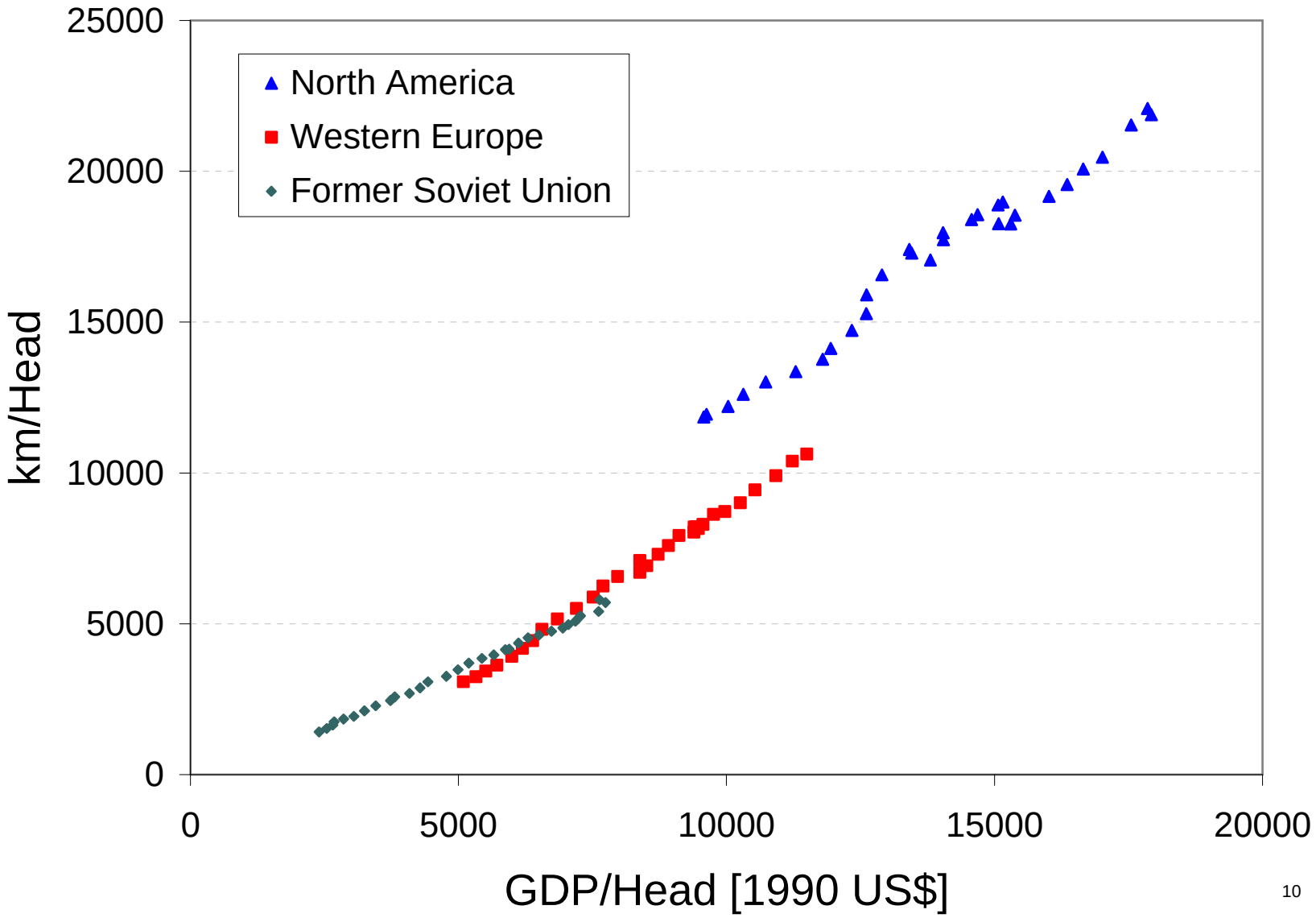


Response: Swiss Suburbanisation since 1970



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

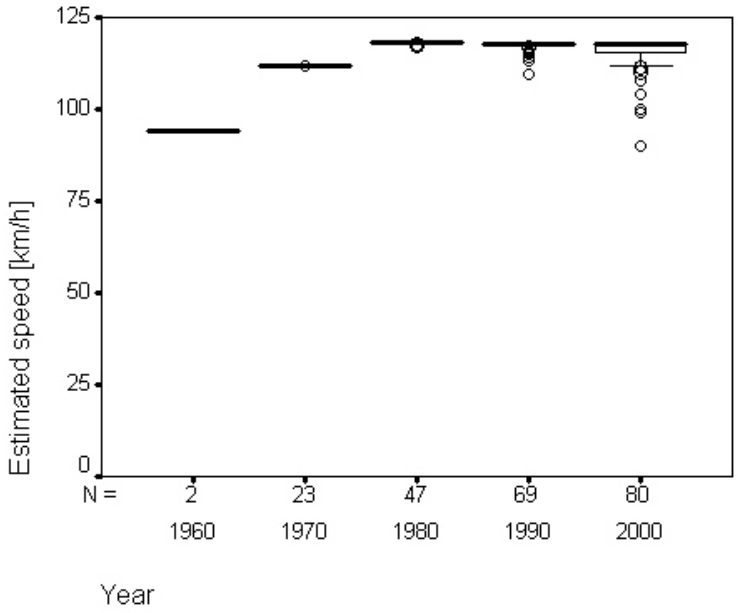
Tracking the road and public transport-based accessibility changes in Switzerland from 1850.

$$Acc_i = \sum_{\forall ij} X_j \, e^{-\beta c_{ij}}$$

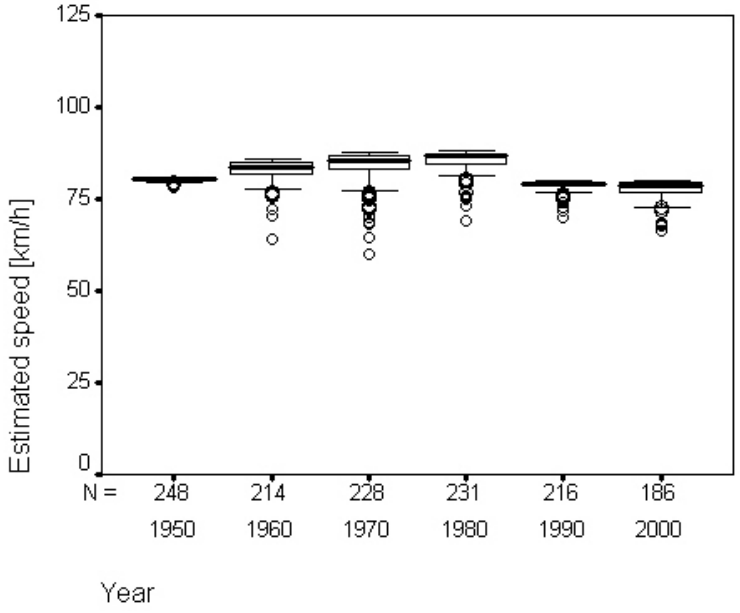
Using:

- Weighting parameter (β) of 0.2
- Travel time as the only generalised cost element (c_{ij})
- Population as number of opportunities (X_j)

Switzerland: Changing speeds



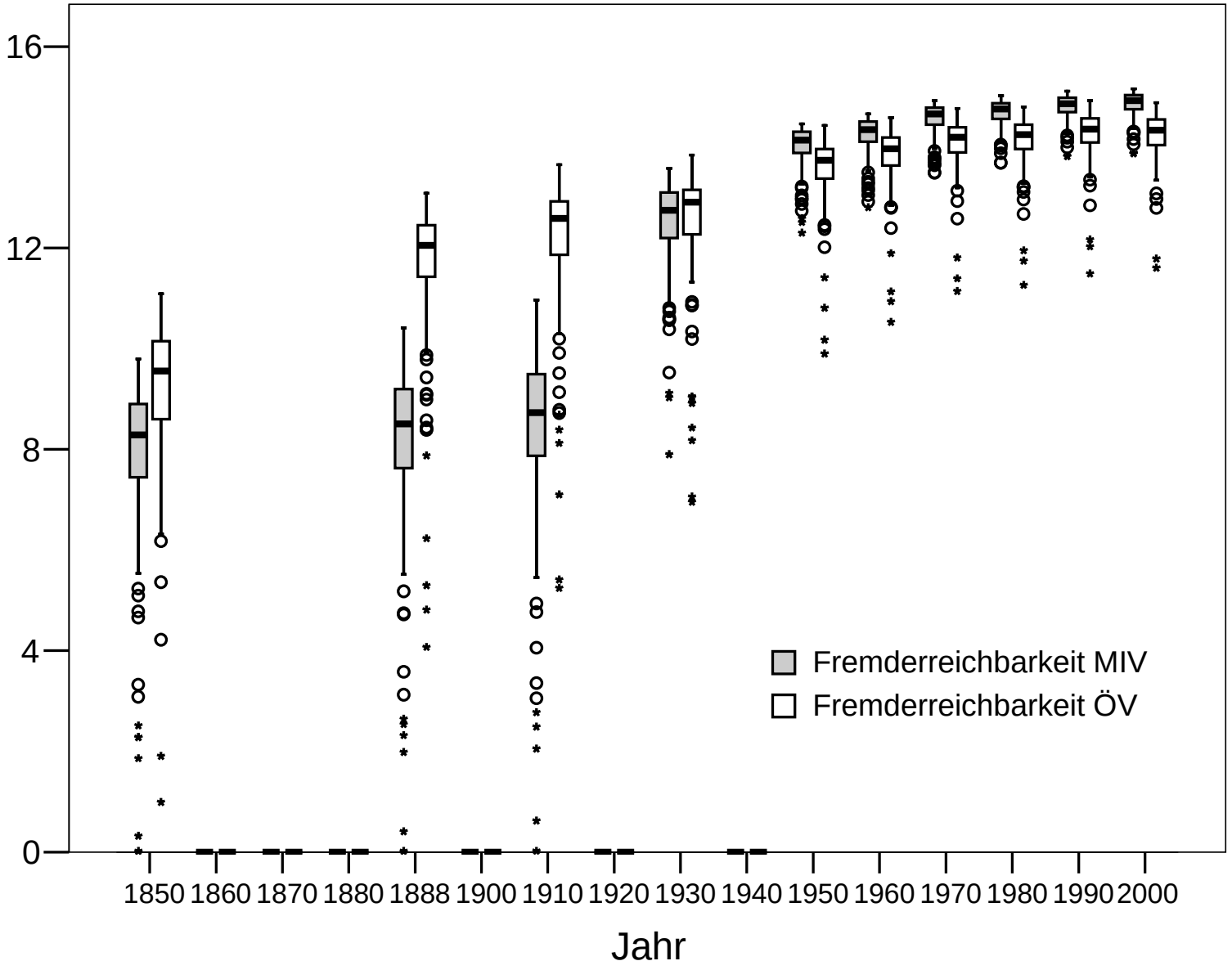
Two-lane motorways



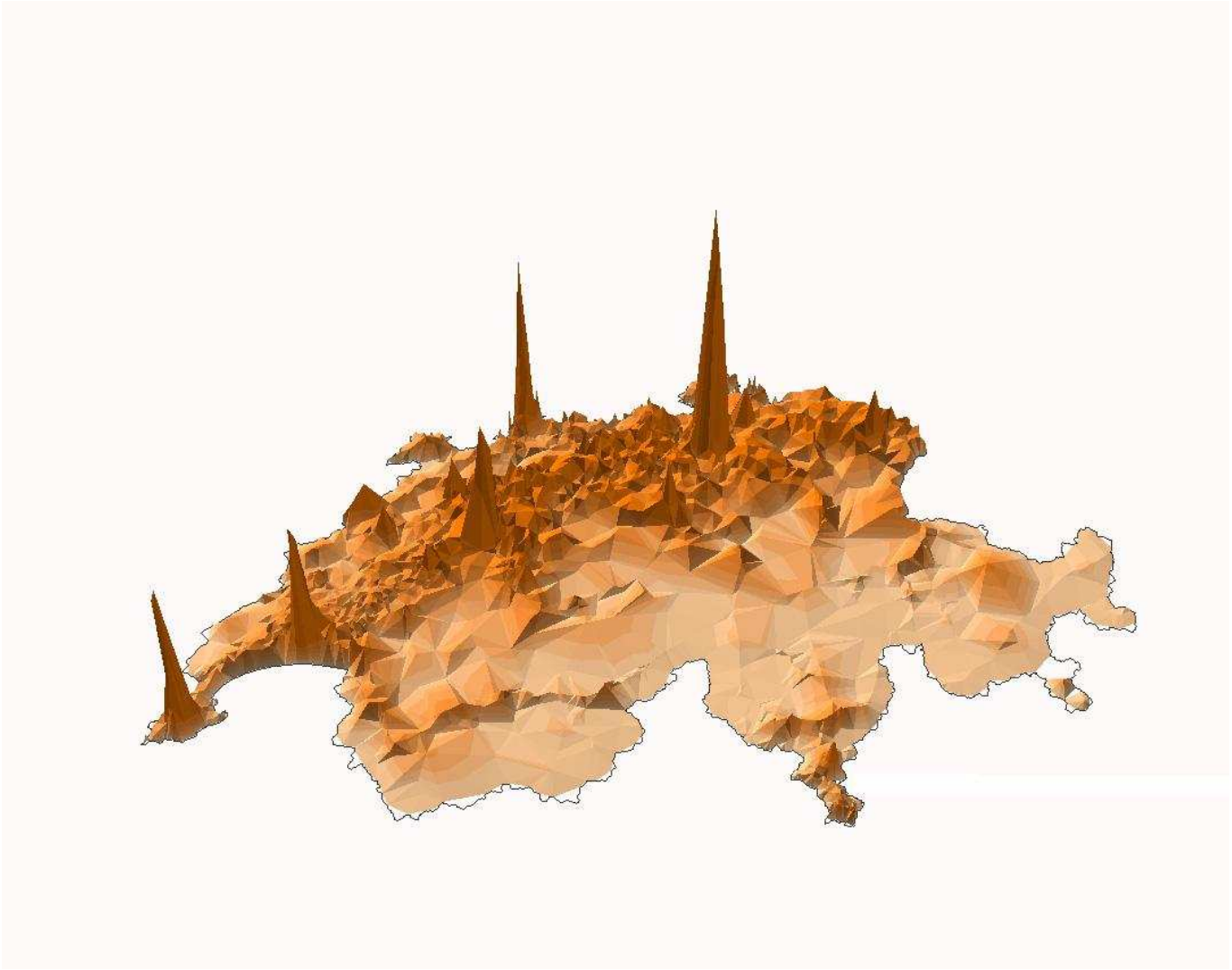
Trunk roads

Axhausen und Fröhlich, 2004

Accessibilities of the Bezirke since 1850

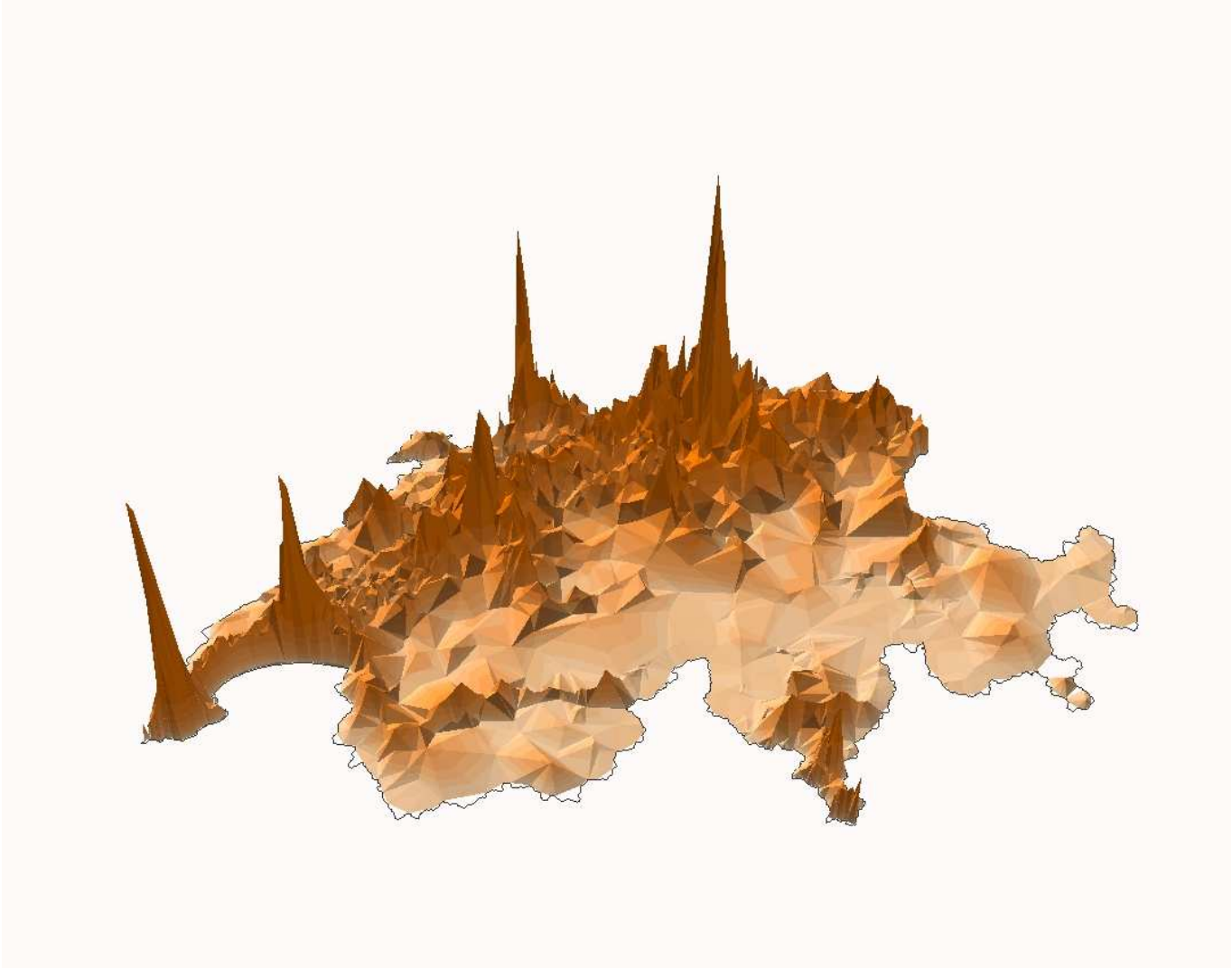


Absolut accessibilities (road) (1950)



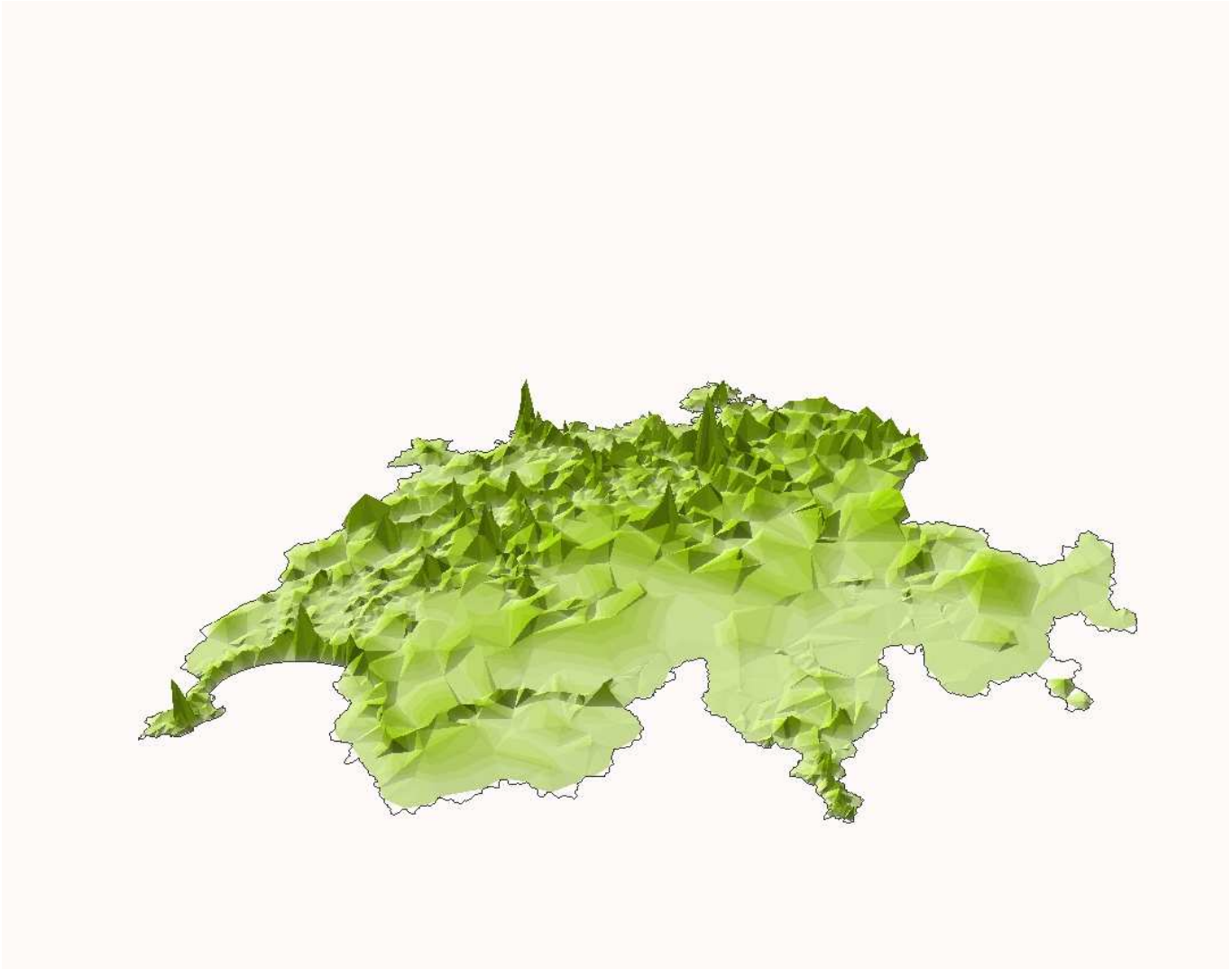
Fröhlich

Absolut accessibilities (road) (2000)



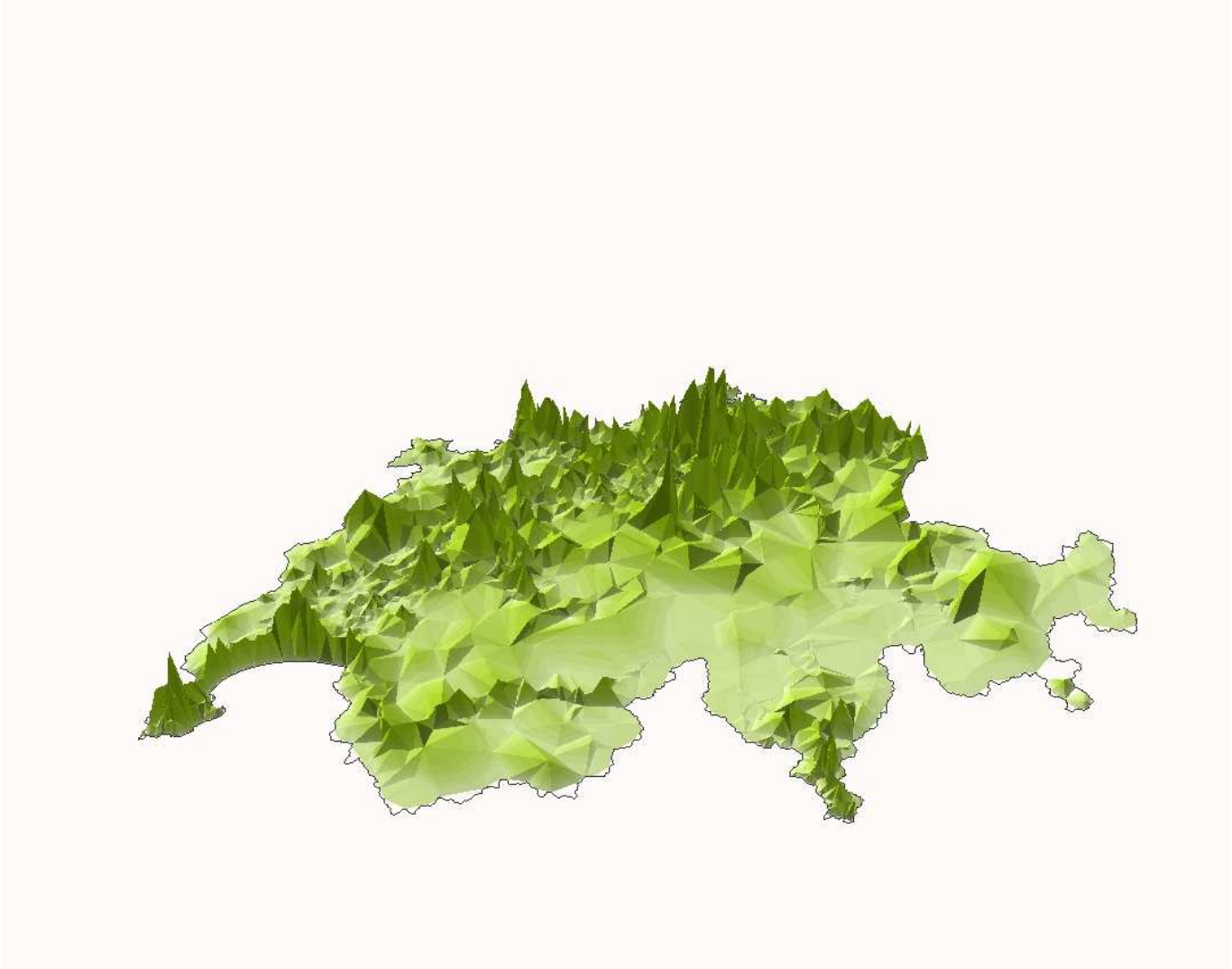
Fröhlich

Absolut accessibilities (public transport) (1950)



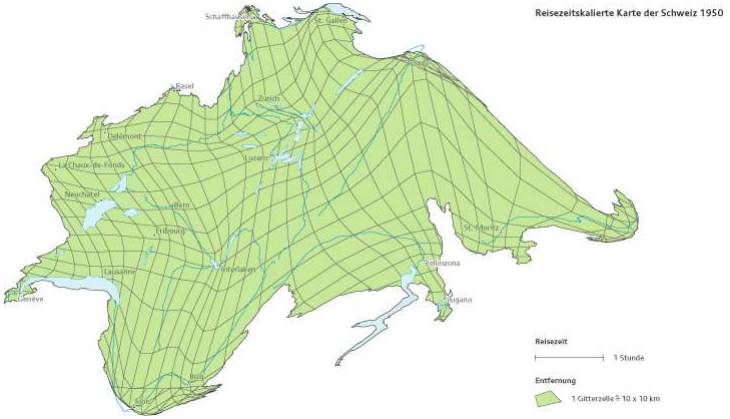
Fröhlich

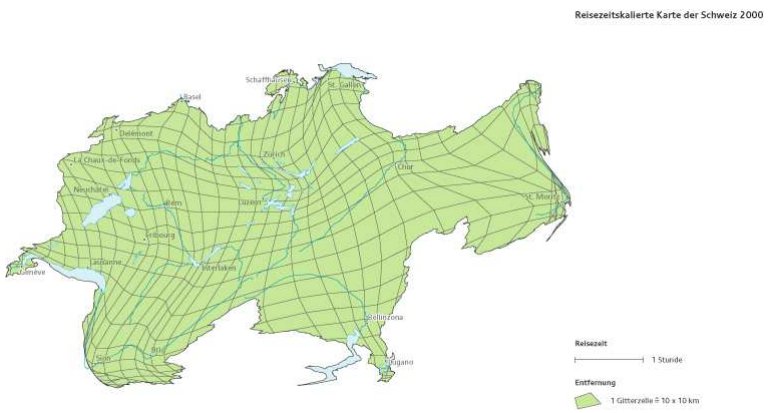
Absolut accessibilities (public transport) (2000)



Fröhlich

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

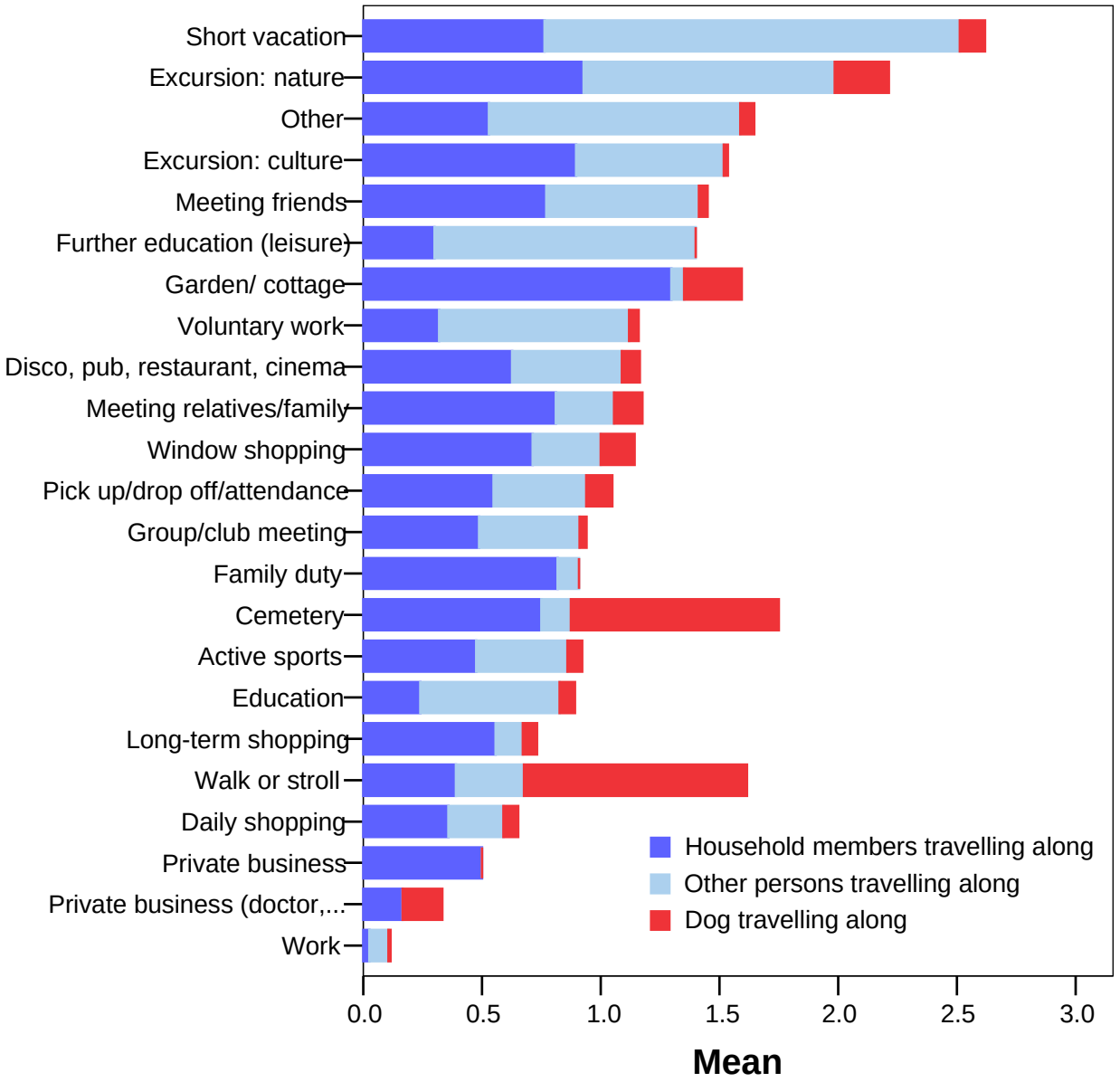
- Adding further points
- Rescaling using the OLS criteria

- Smoothing all other points using the known rescalings
- „Rubbersheet“ the map using the dense set of rescalings

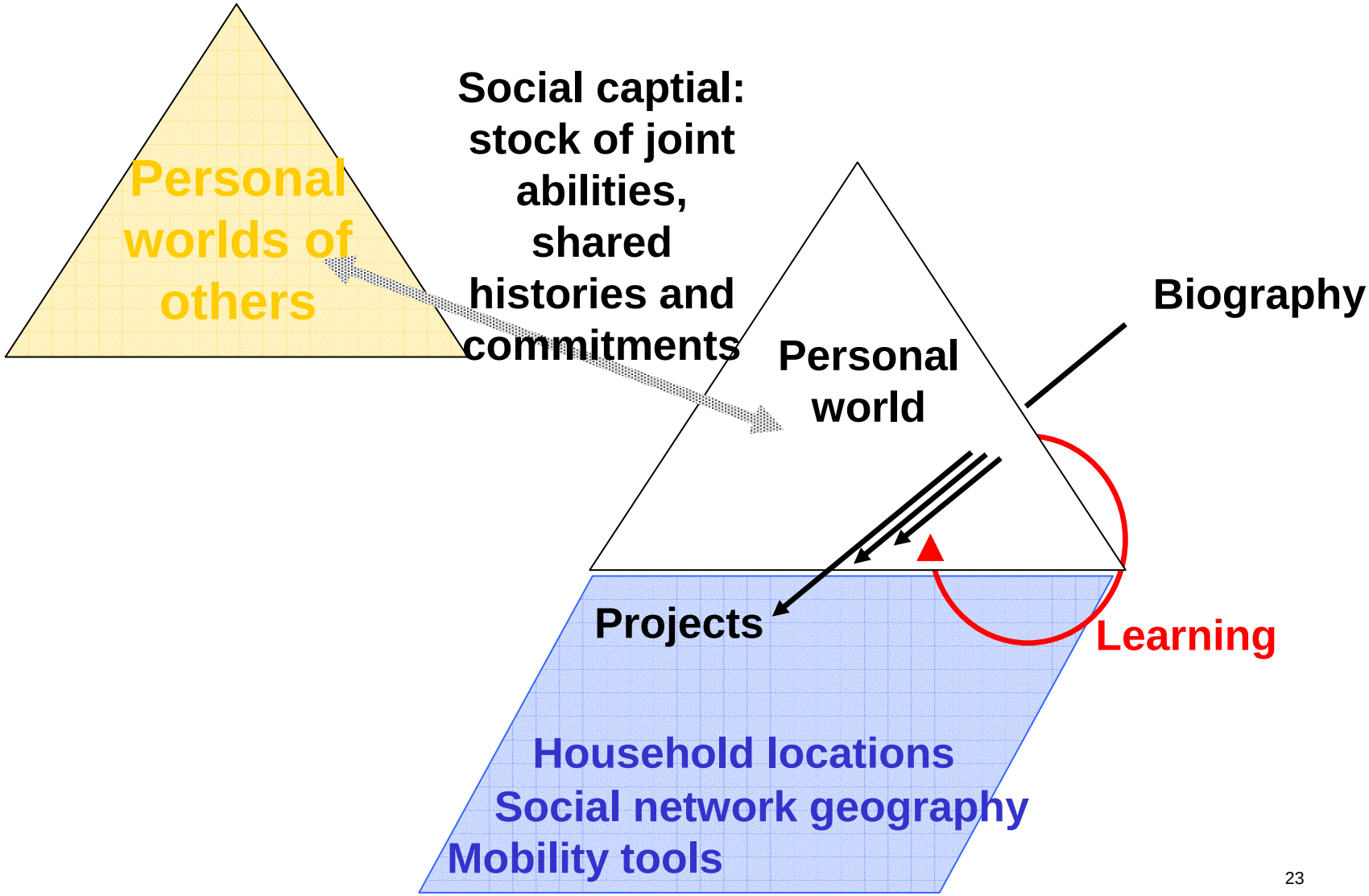
Kilometers travelled by purpose [%]

Purpose	CH - 2000	D – 2002	UK - 2003	USA - 1995
Leisure	44.8	38.3	33.7	32.2
Work and school	35.0	29.7	32.0	31.3
Shopping/Private business	11.2	21.7	19.7	27.6
Accompanying	4.9	4.5	7.6	8.5
Other	1.8	4.8	7.1	0.5

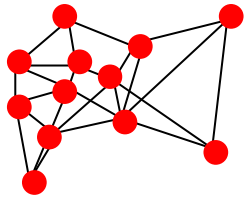
The social content of travel (2003 Thurgau)



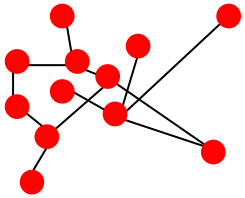
The „network actor“ in a dynamic social context



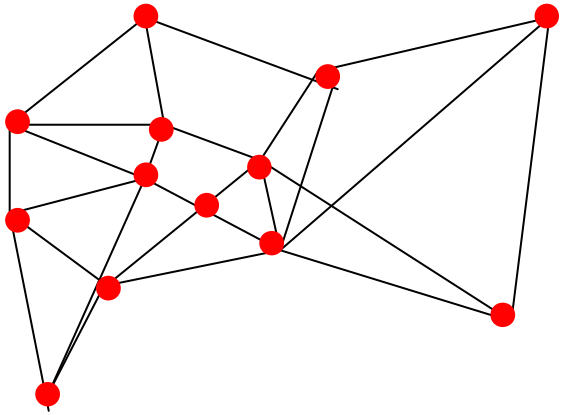
Spatial and social density



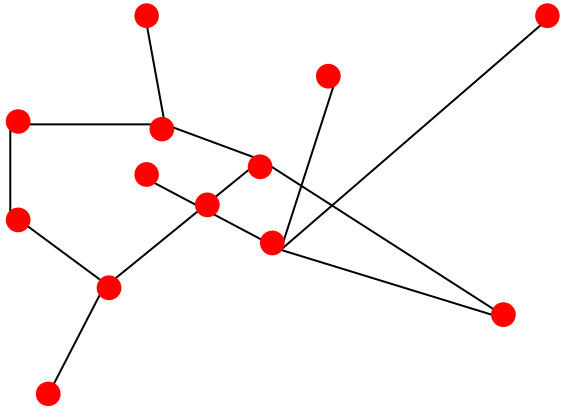
Dense/tight



Dense/loose

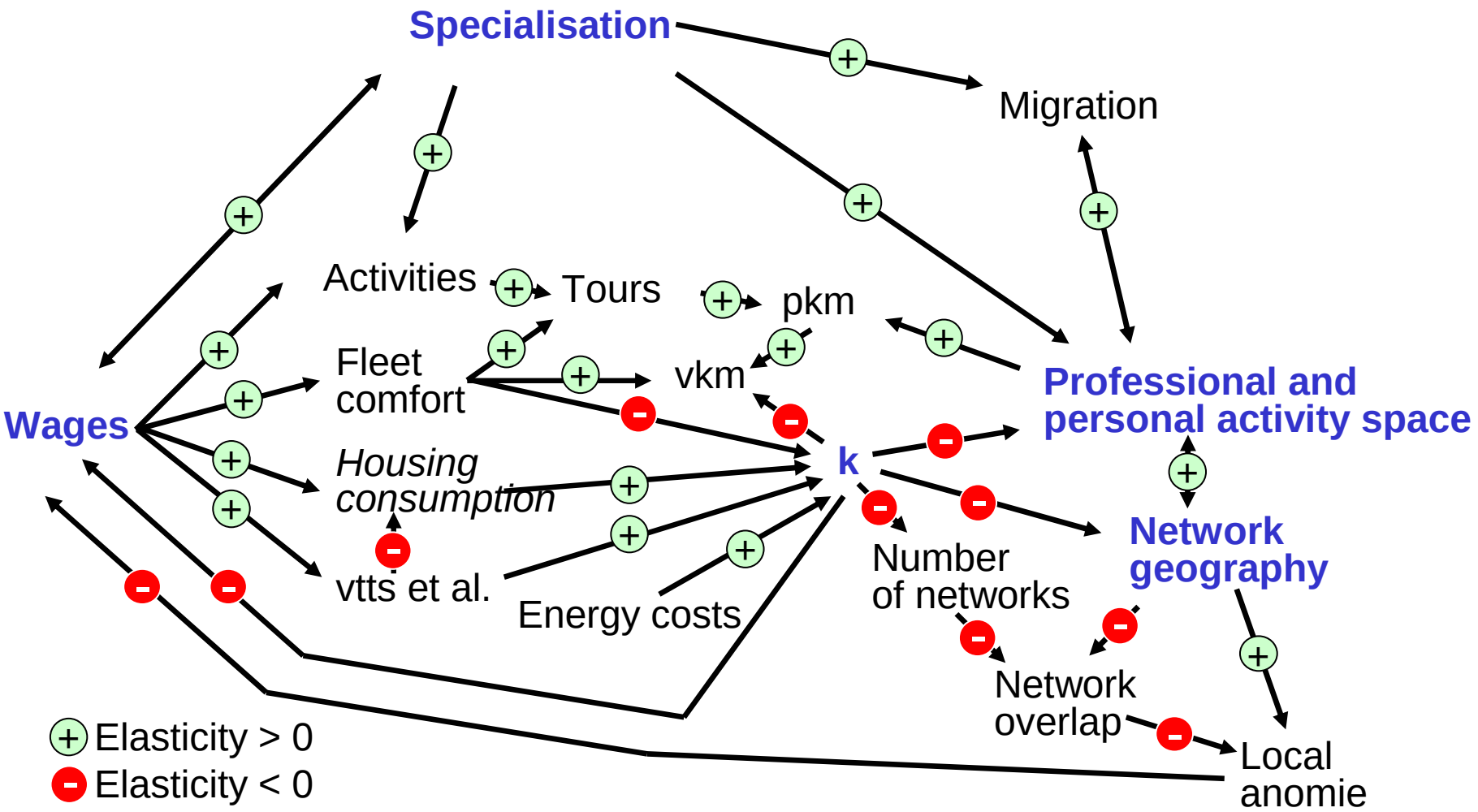


Sparse/tight

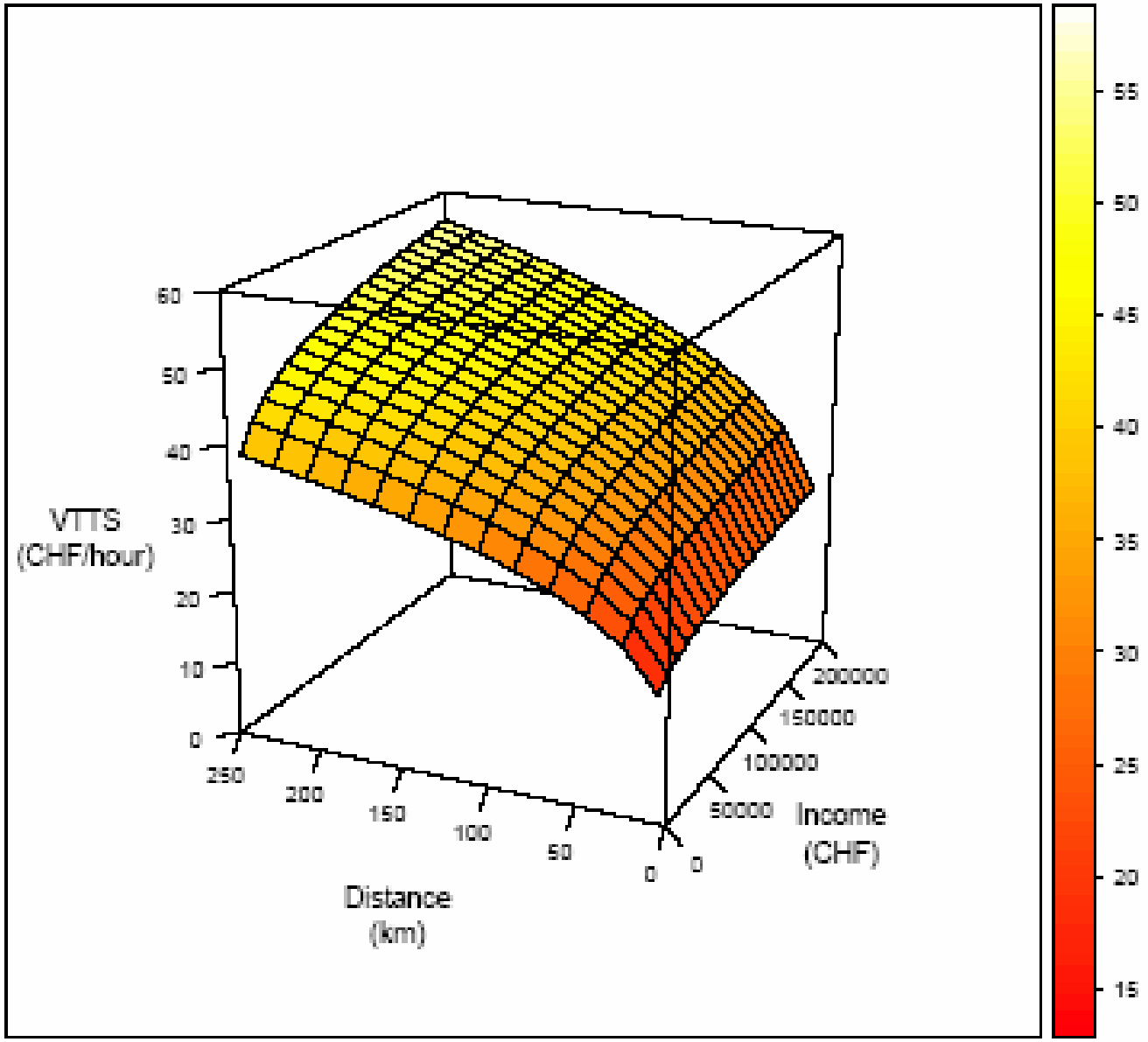


Sparse/loose

Activity spaces & network geographies: A partial hypothesis

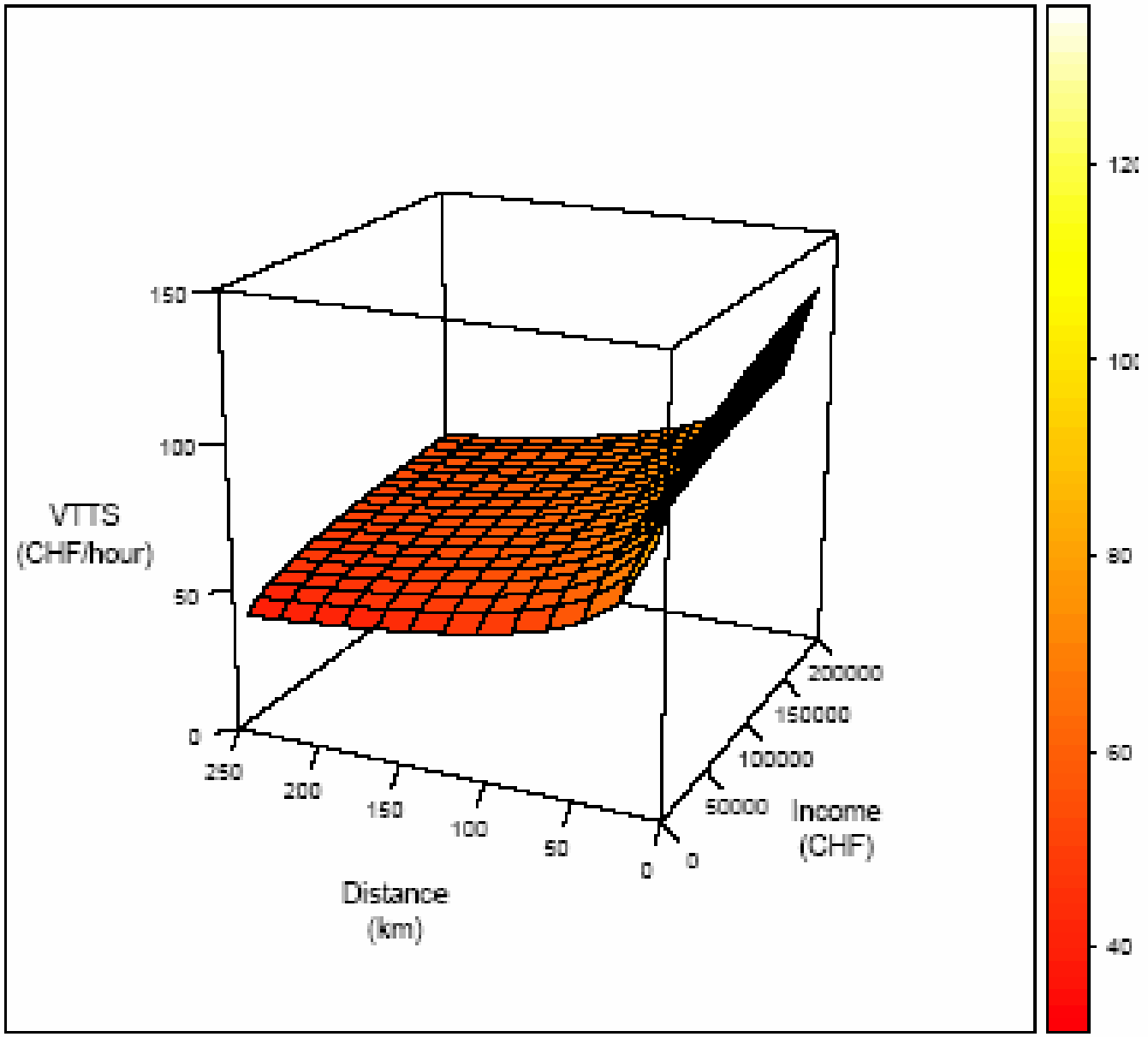


Willingness to pay for reduction of free-flow travel time



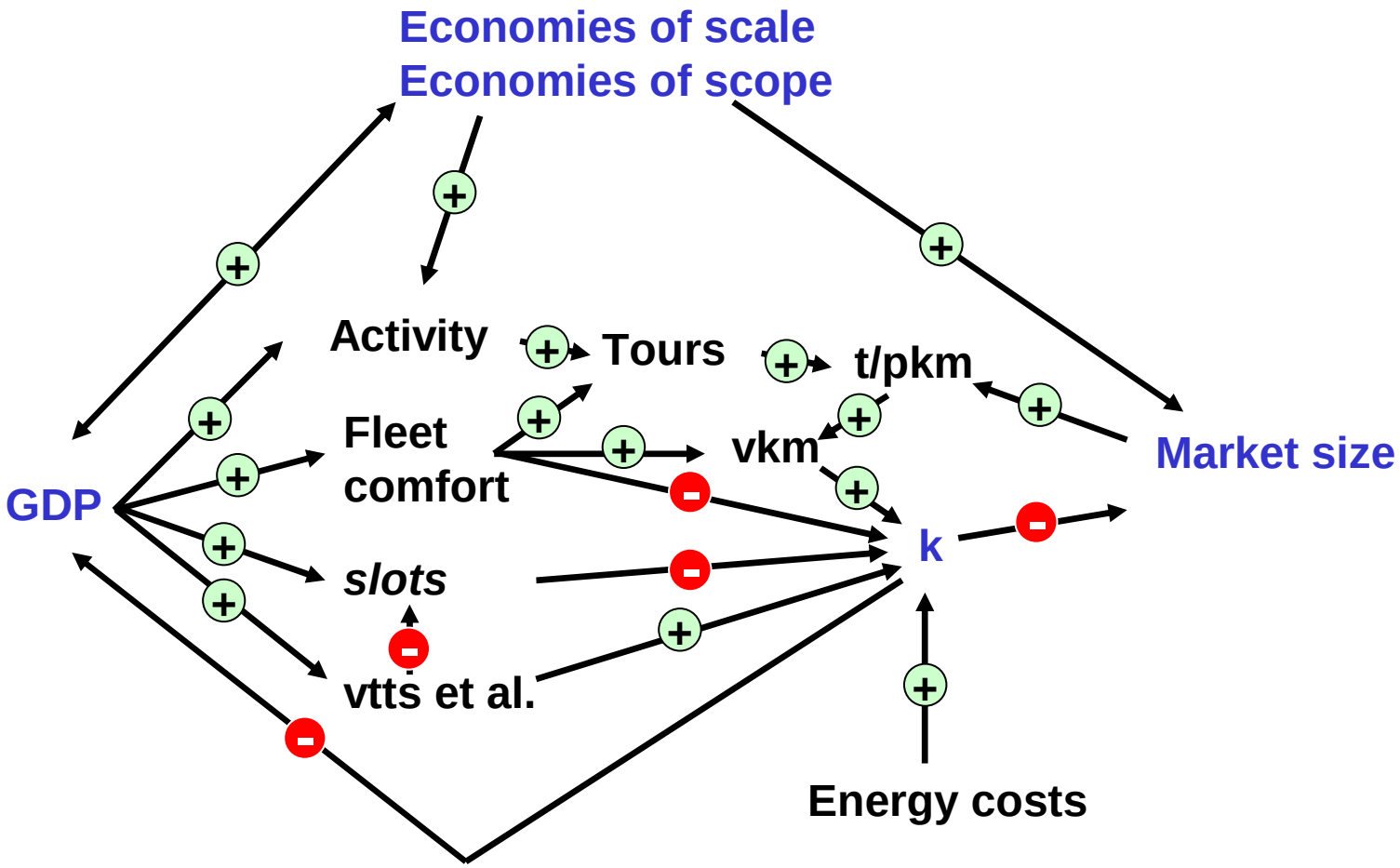
Axhausen, Hess, König, Bierlaire, Bates and Abay, 2006

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



⊕ Elasticity > 0
⊖ Elasticity < 0

Slots: possibilities to move goods or people
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

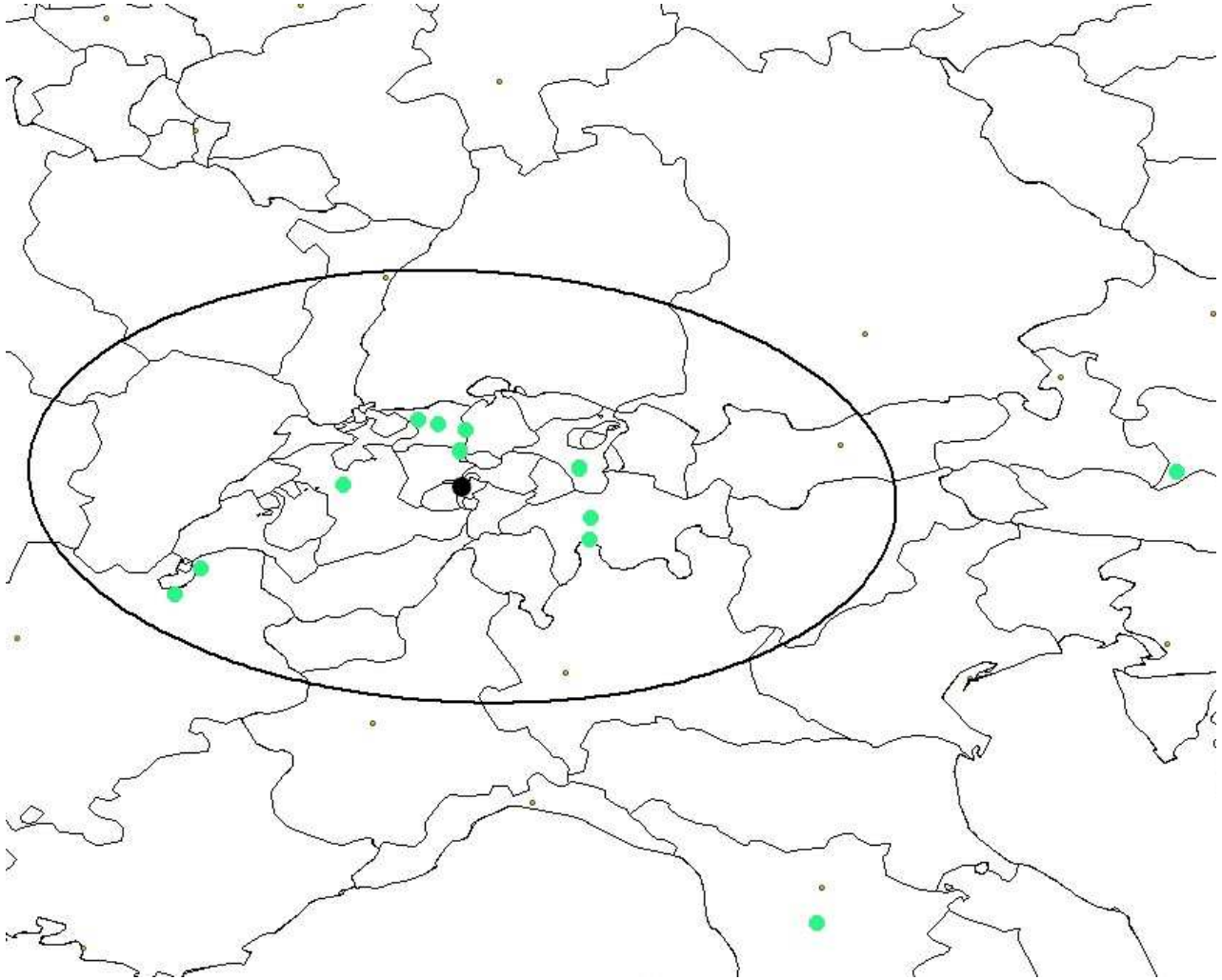
Semiparametric:

- Kernel density estimator
- Inclusion geometries
- Shortest path networks

Non-parametric

- Observed path geometries

Example of a social network geography

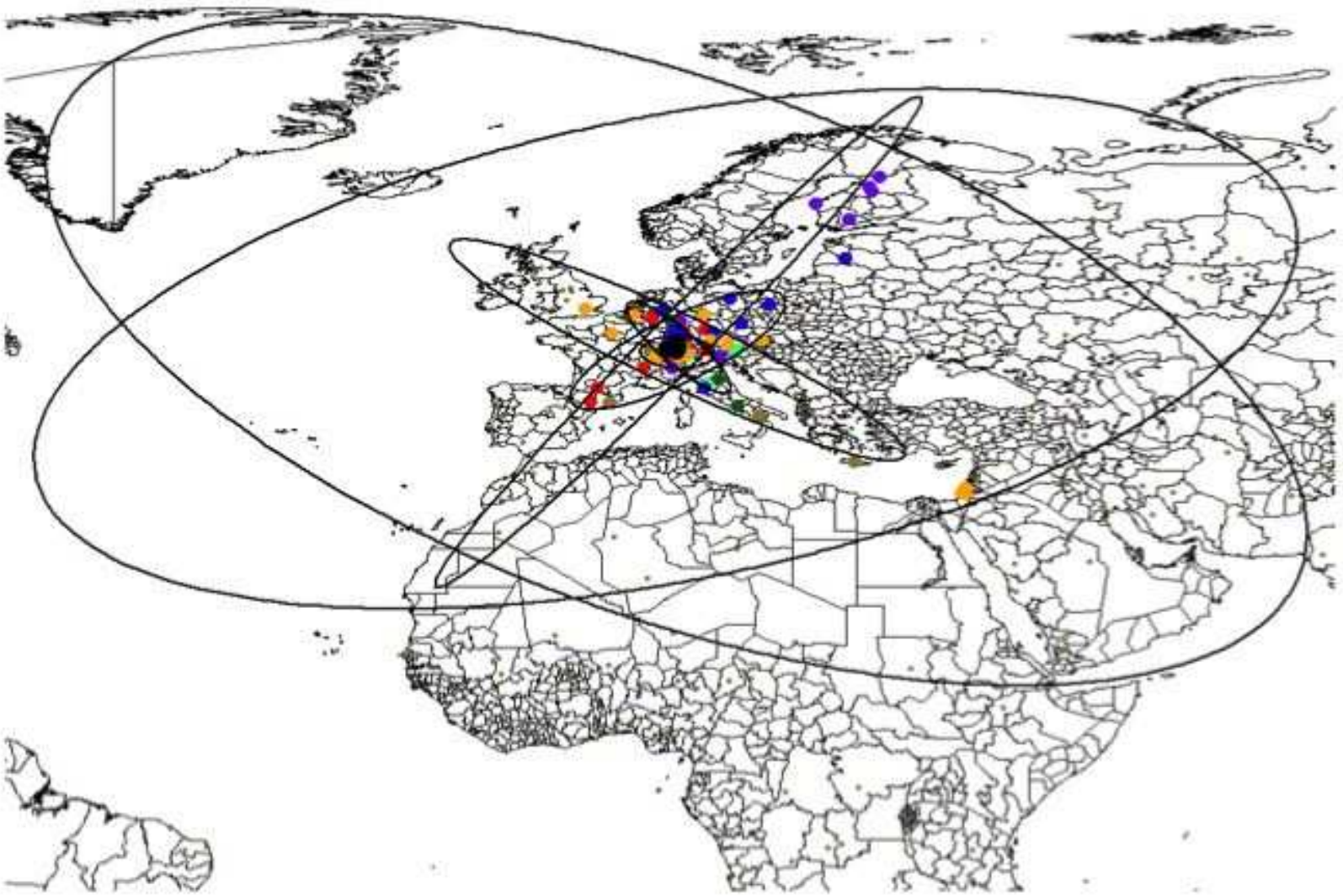


Female, 28,

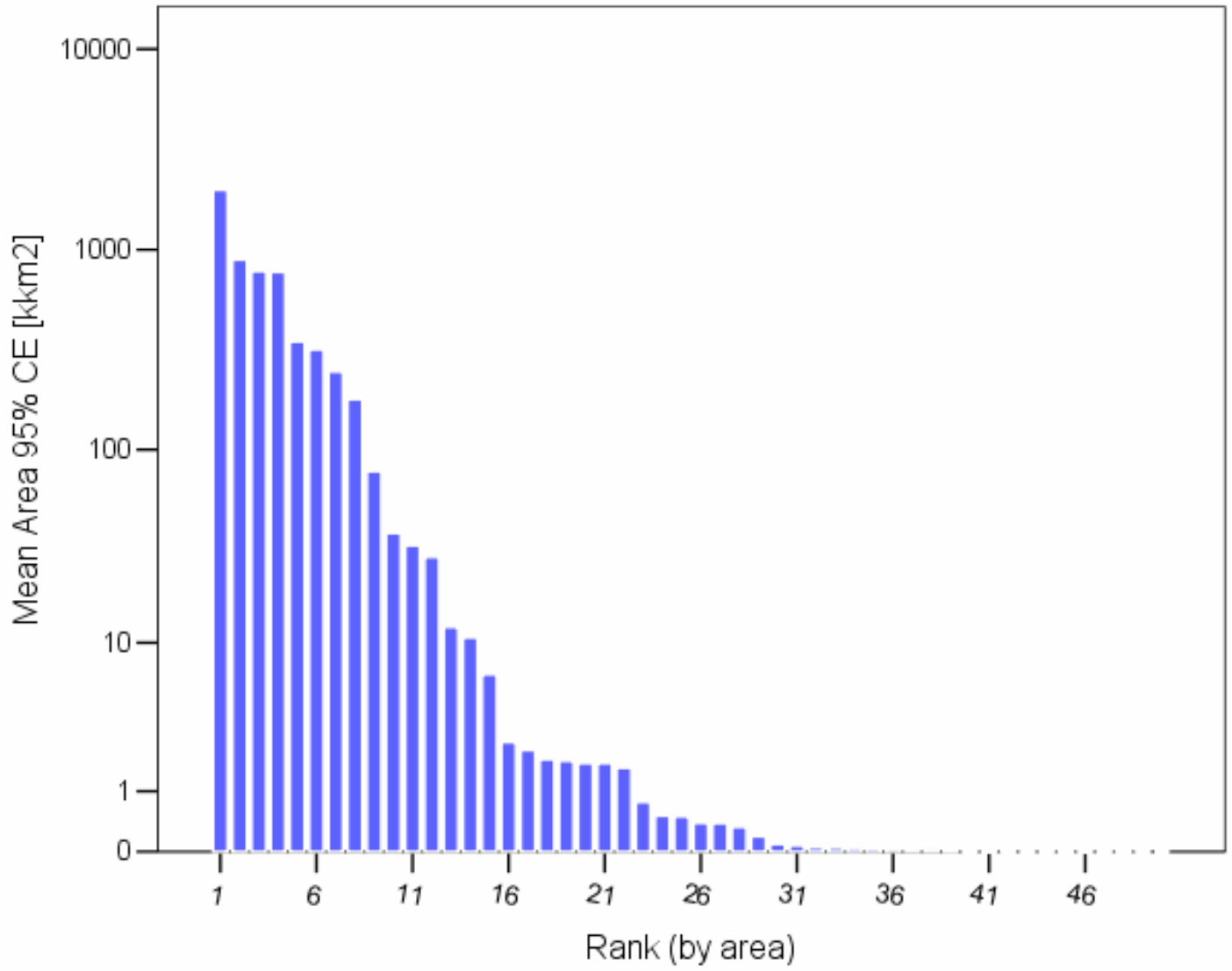
4 moves,

Ohnmacht, 2004

More examples

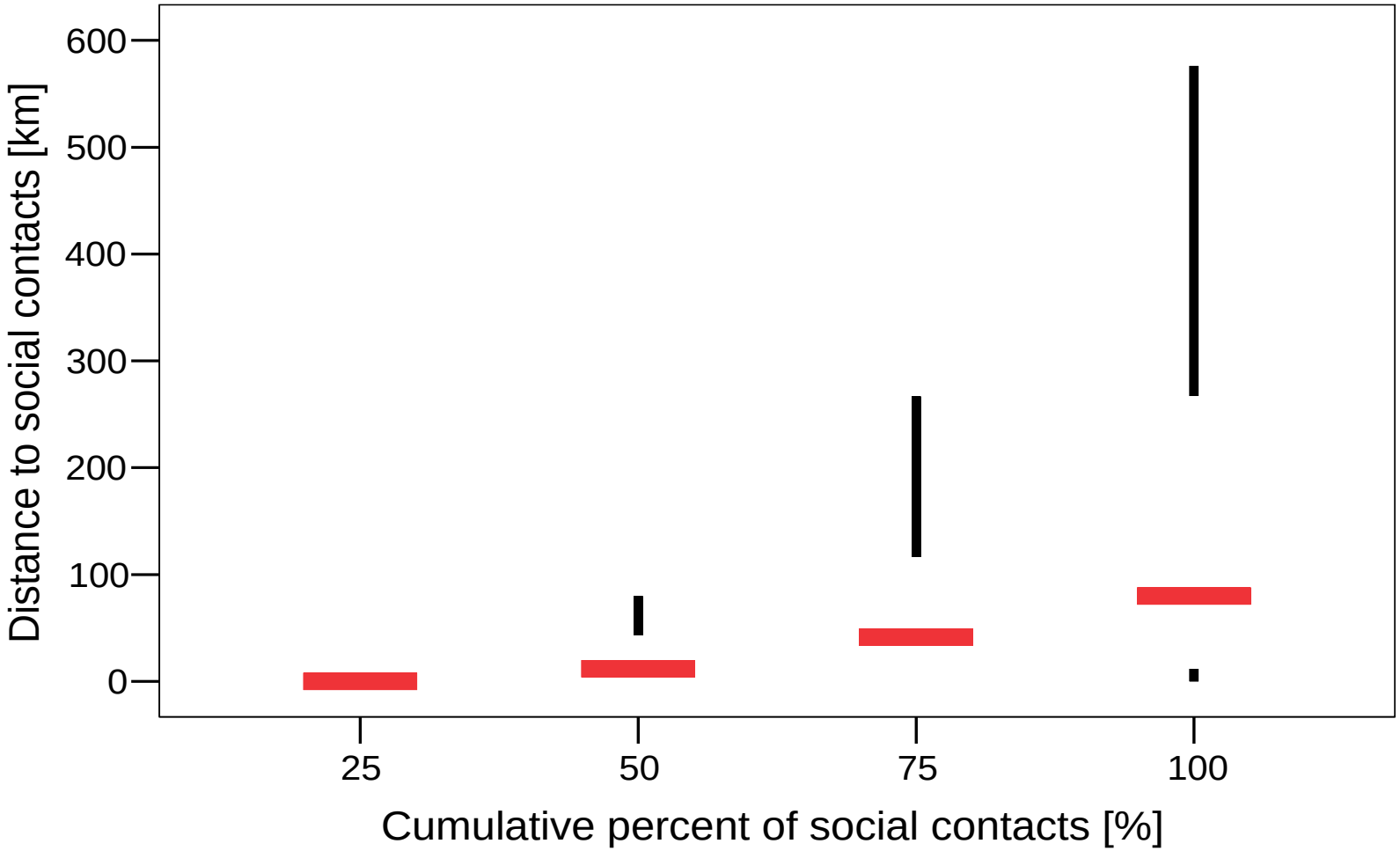


Distribution of the social network geographies (95% CE)

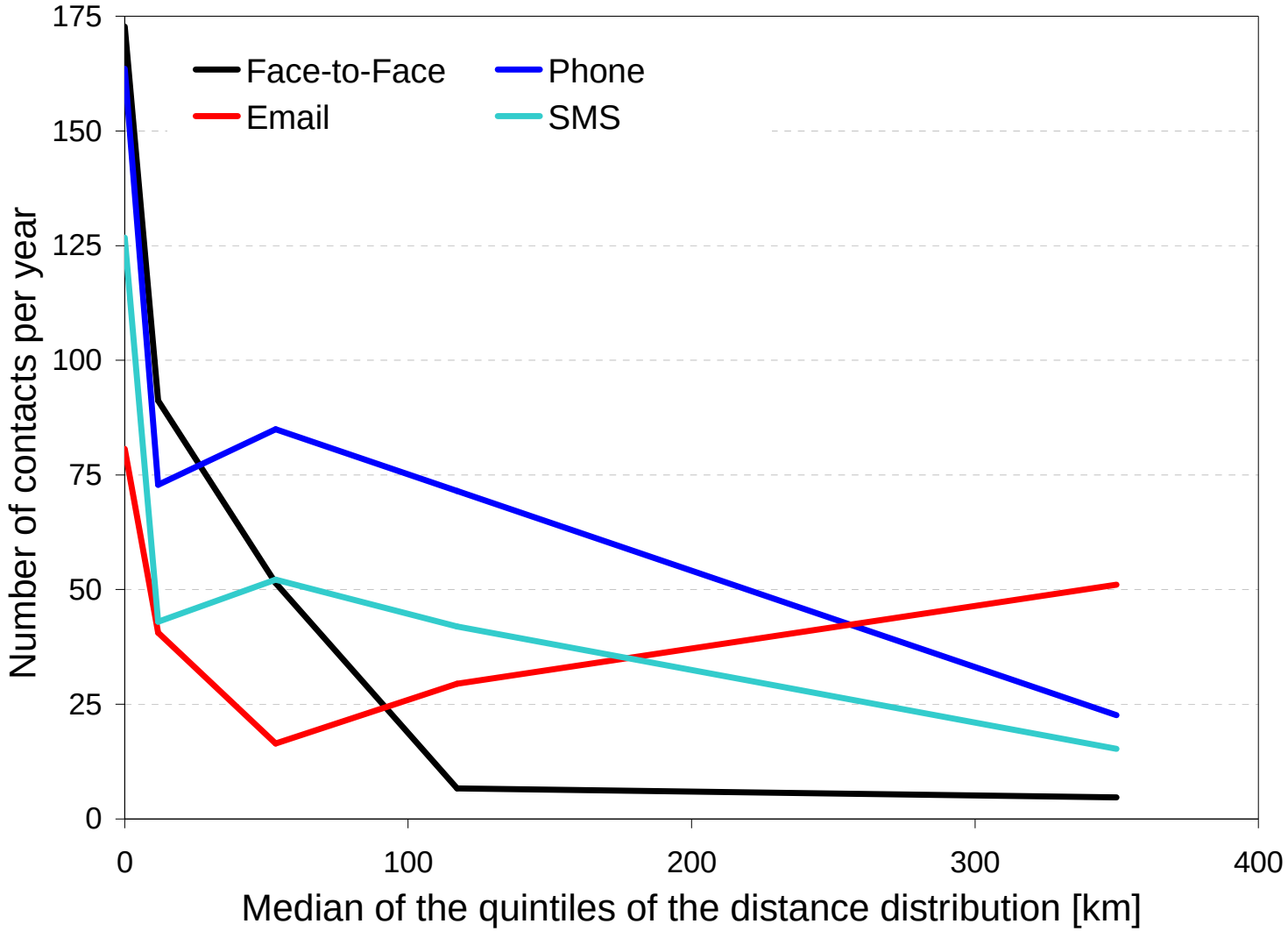


Both samples

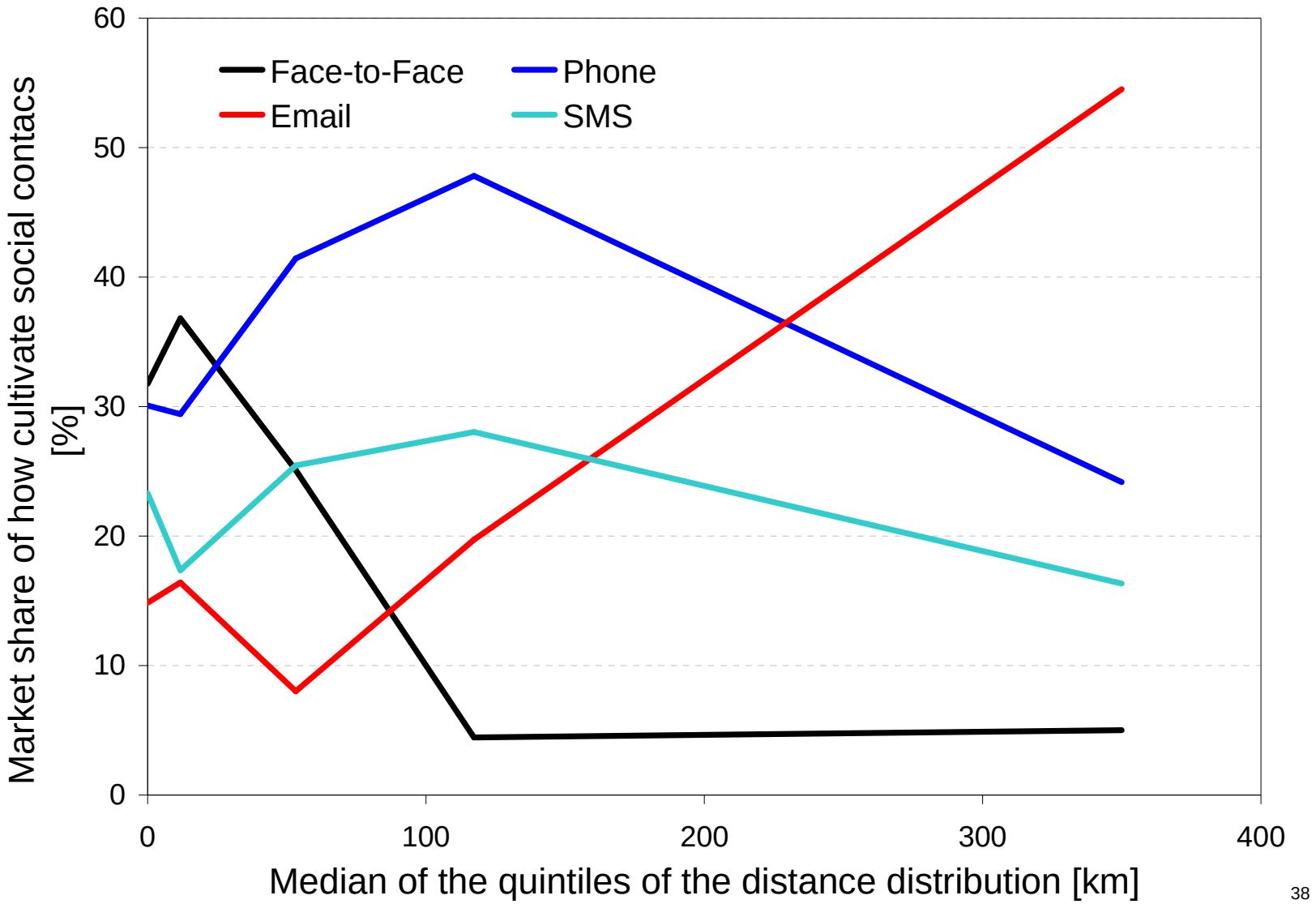
Distribution of the interpersonal distances (Horizon)



Channels of communication by distance (Horizon)



Channels of communication by distance (Horizon)



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 happend ?

- Is localised anomie real ?
- How costly is ist ?

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 adddress ?
- What are the (cross)-elasticities between the modes of contact ?

Appendix

Description of Elements: Overview

Study area:	Switzerland and surrounding jurisdictions in a 350 km band
Spatial resolution:	Municipality equals one zone/Bezirk Larger municipalities are subdivided Zones outside Switzerland on regional or county level
Intrazonal travel times:	Dependent on equivalent radius of the size of the built up area

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

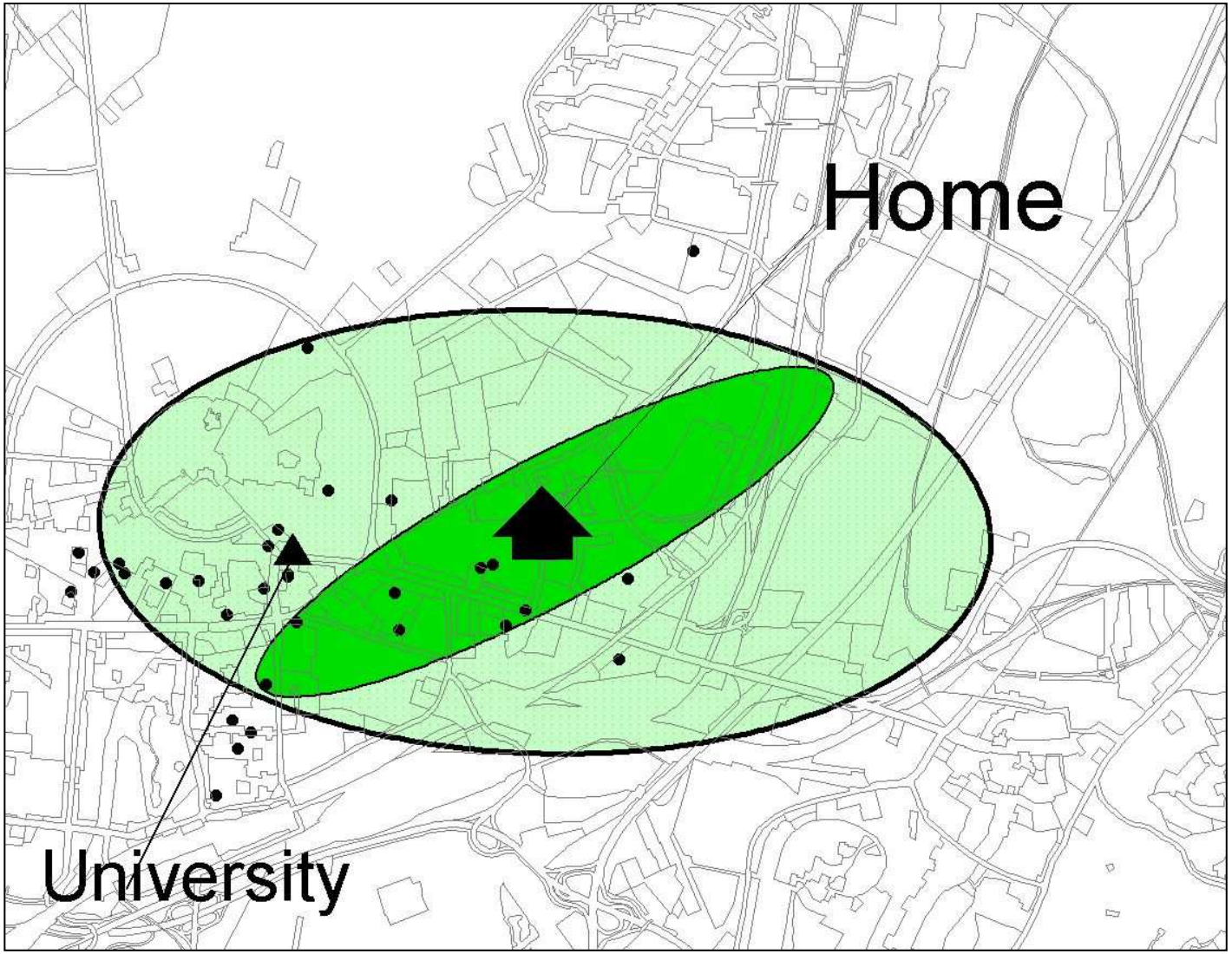
Matching the census the reference areas are:

- 1850, 1888, 1910, 1930 Only Bezirke
- 1950 and then each decade Municipalities and Bezirke

Road network models

Year	mod. Links CH	Total CH Links CH	mod. Links EU	Total Links EU
1950	3’527	17’698	136	29’248
1960	3’589	17’760	195	29’307
1970	4’147	18’318	422	29’534
1980	4’810	18’981	747	29’859
1990	5’215	19’386	896	30’008
2000	-	19’700	-	30’053

Measurement approaches: Confidence ellipse



Schönfelder

Measurement approaches: Kernel densities

Schönfelder

Measurement approaches: Inclusion geometries

Find:

$\min A_i(\beta_{i1} \ldots\ldots \beta_{in})$

s.t.

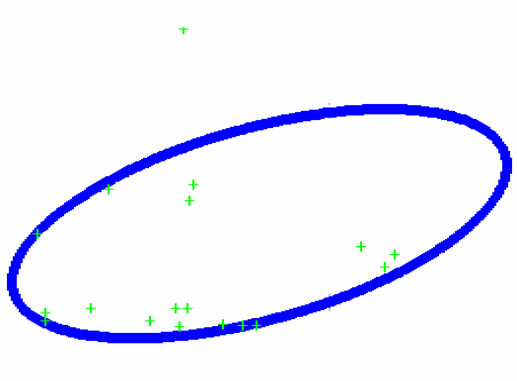
Area A_i covering p% of all observed points

with:

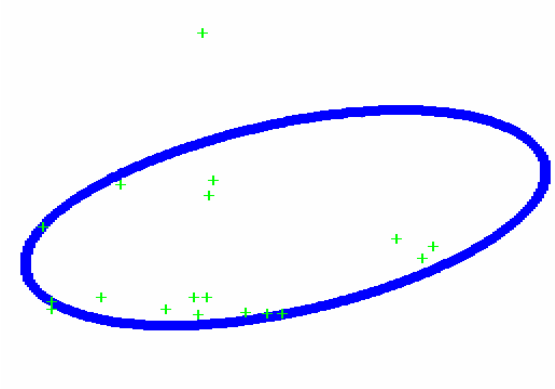
i	:	Type of geometry (Ellipse, bean, Cassini ...)
p	:	Predetermined share, e.g. 95%

Measurement approaches: Inclusion geometries

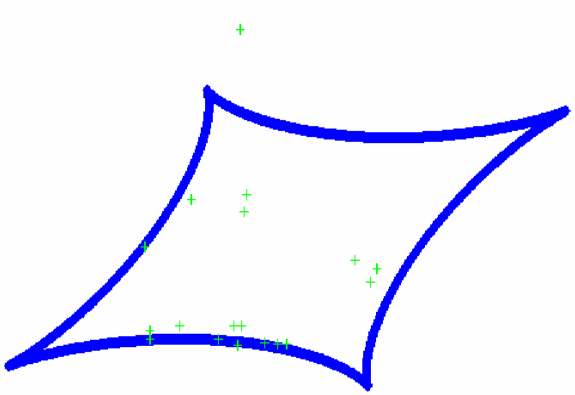
Ellipse



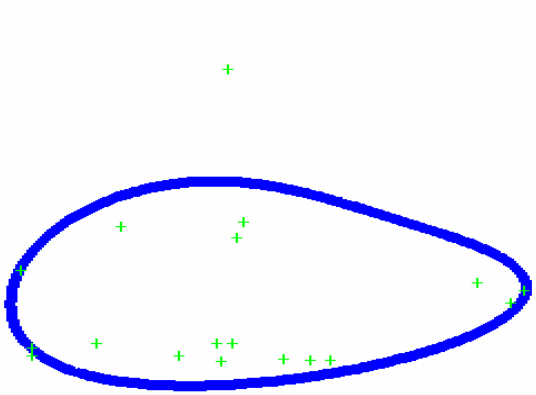
Superellipse 1



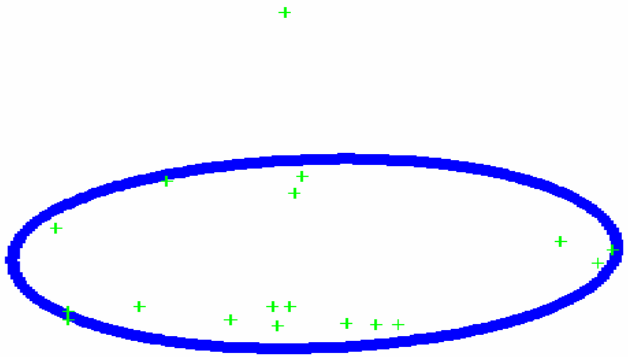
Superellipse 2



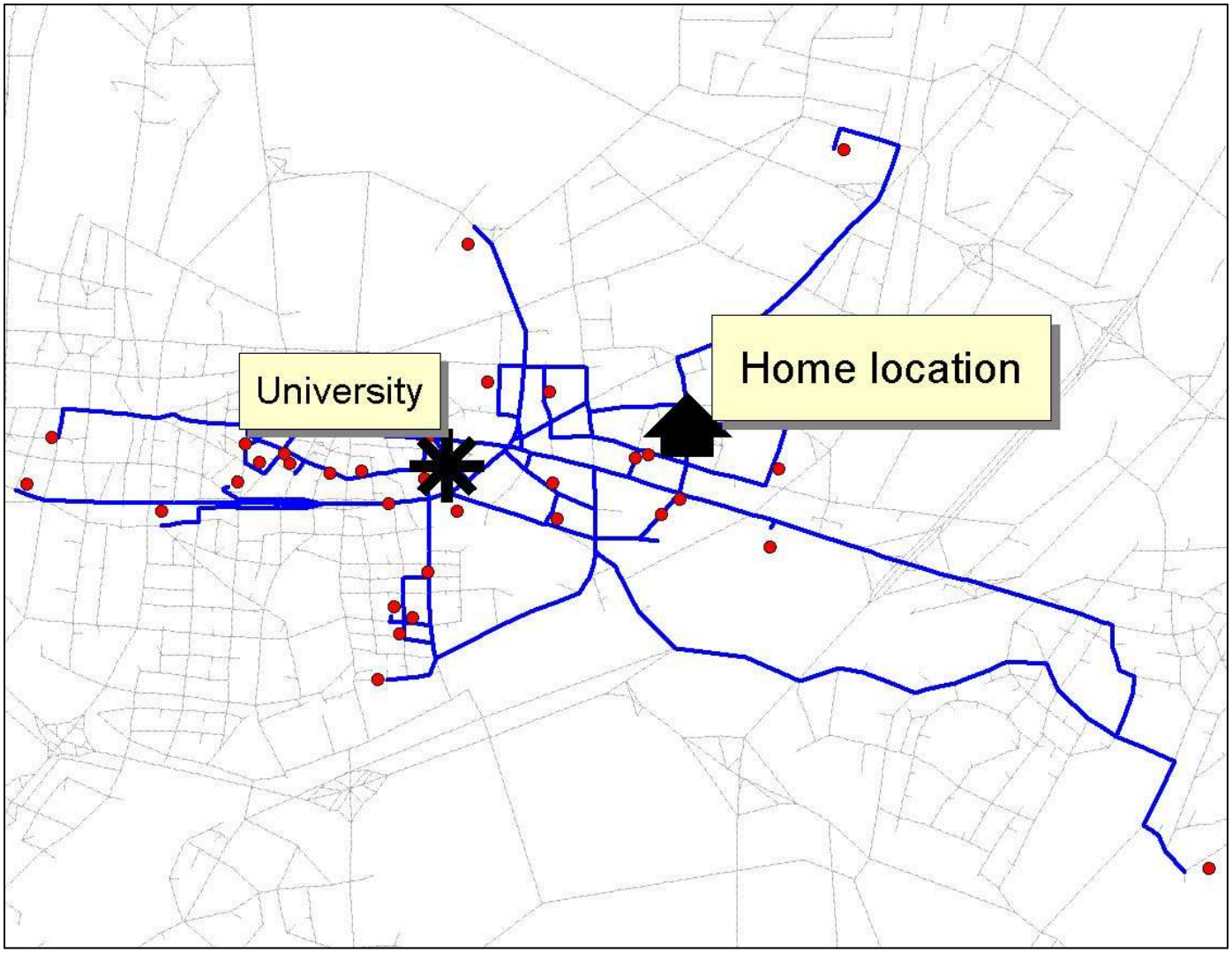
Bean



Cassini

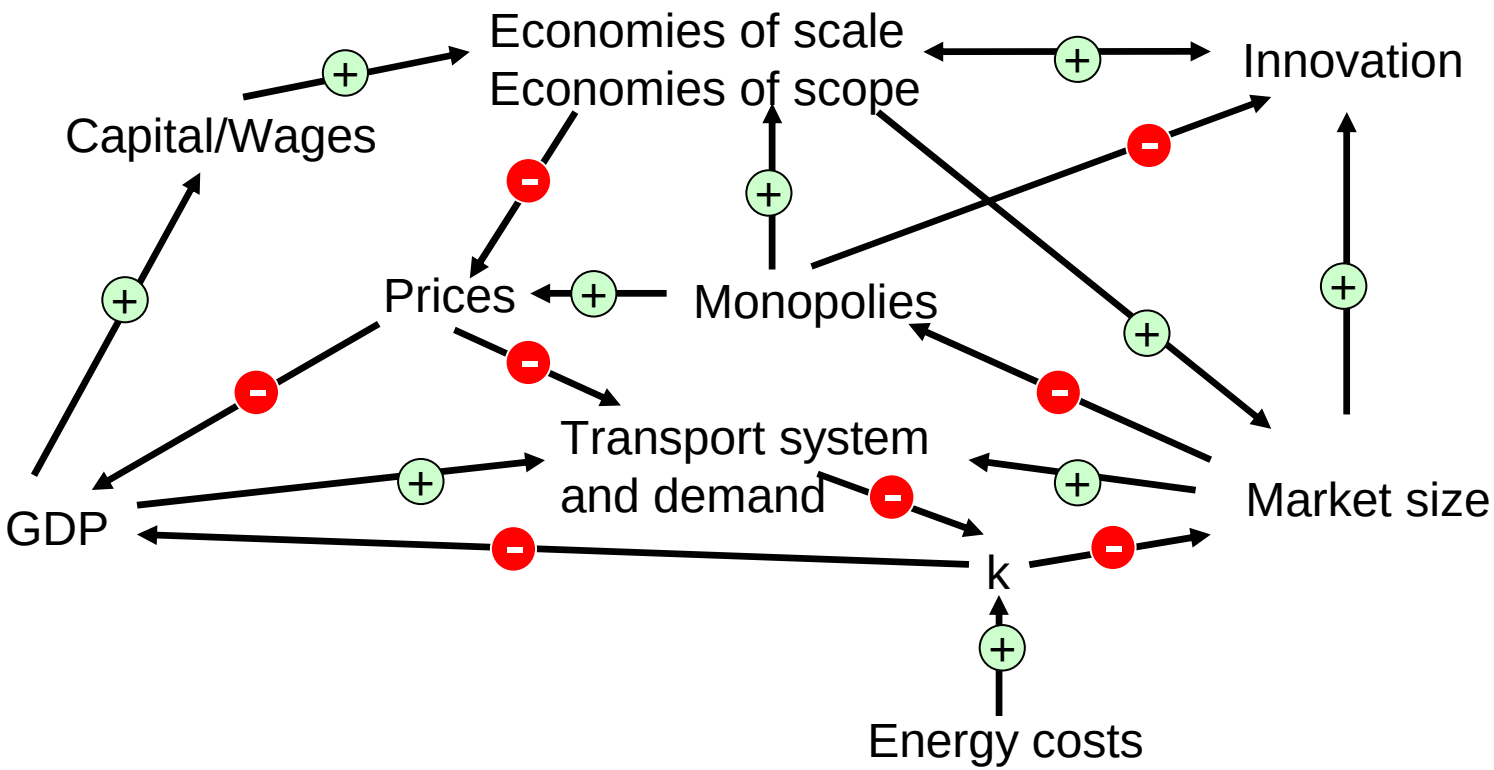


Measurement approaches: Shortest path network



Schönfelder

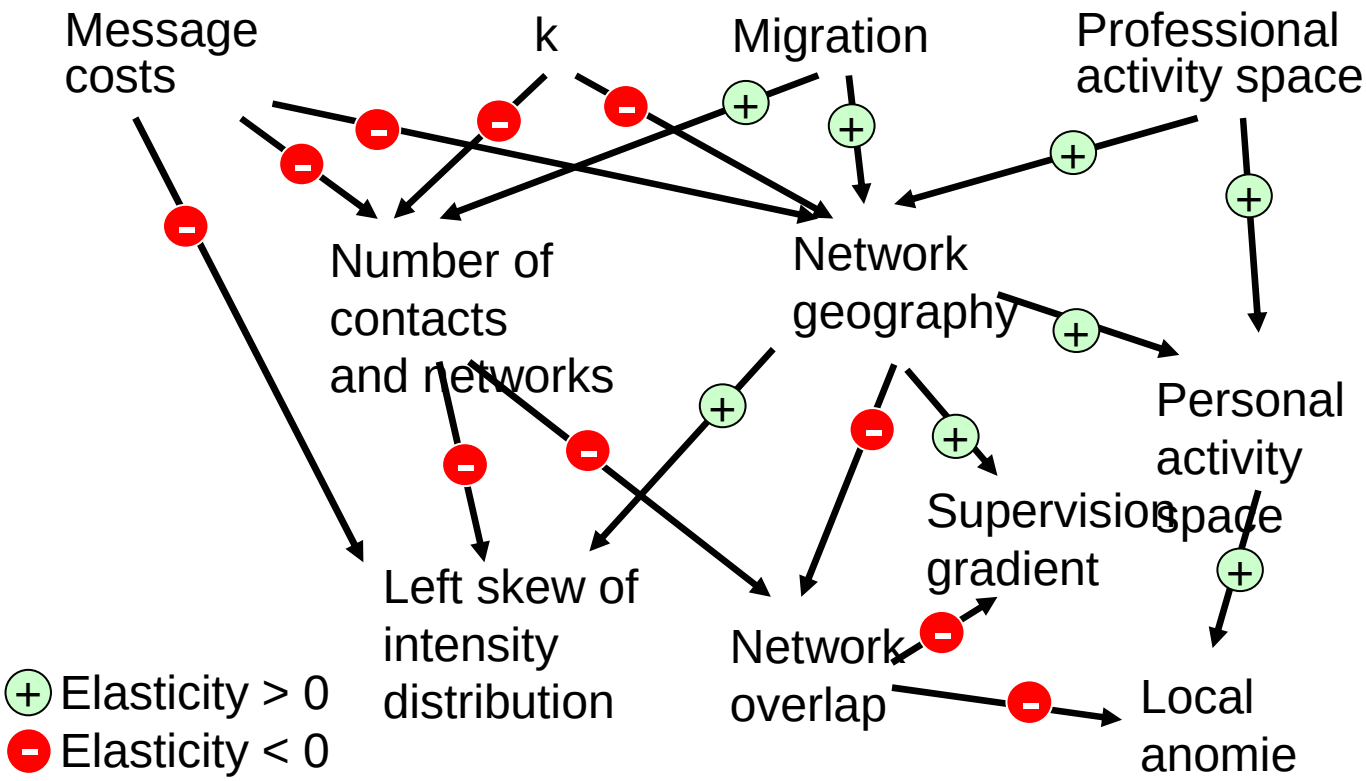
Size of goods markets and productivity: A hypothesis



+ Elastizität > 0
- Elastizität < 0

k: Generalisierte Kosten

Generalised costs of contact and social networks



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