Bevorzugter Zitierstil

Axhausen, K.W. and C. Zöllig (2011) Social networks and travel: Current status and expected change, Workshop *Emerging issues and methods in policy-oriented travel demand analysis*, Technion, Haifa, June 2011.

How to model the gains from infrastructure investment?

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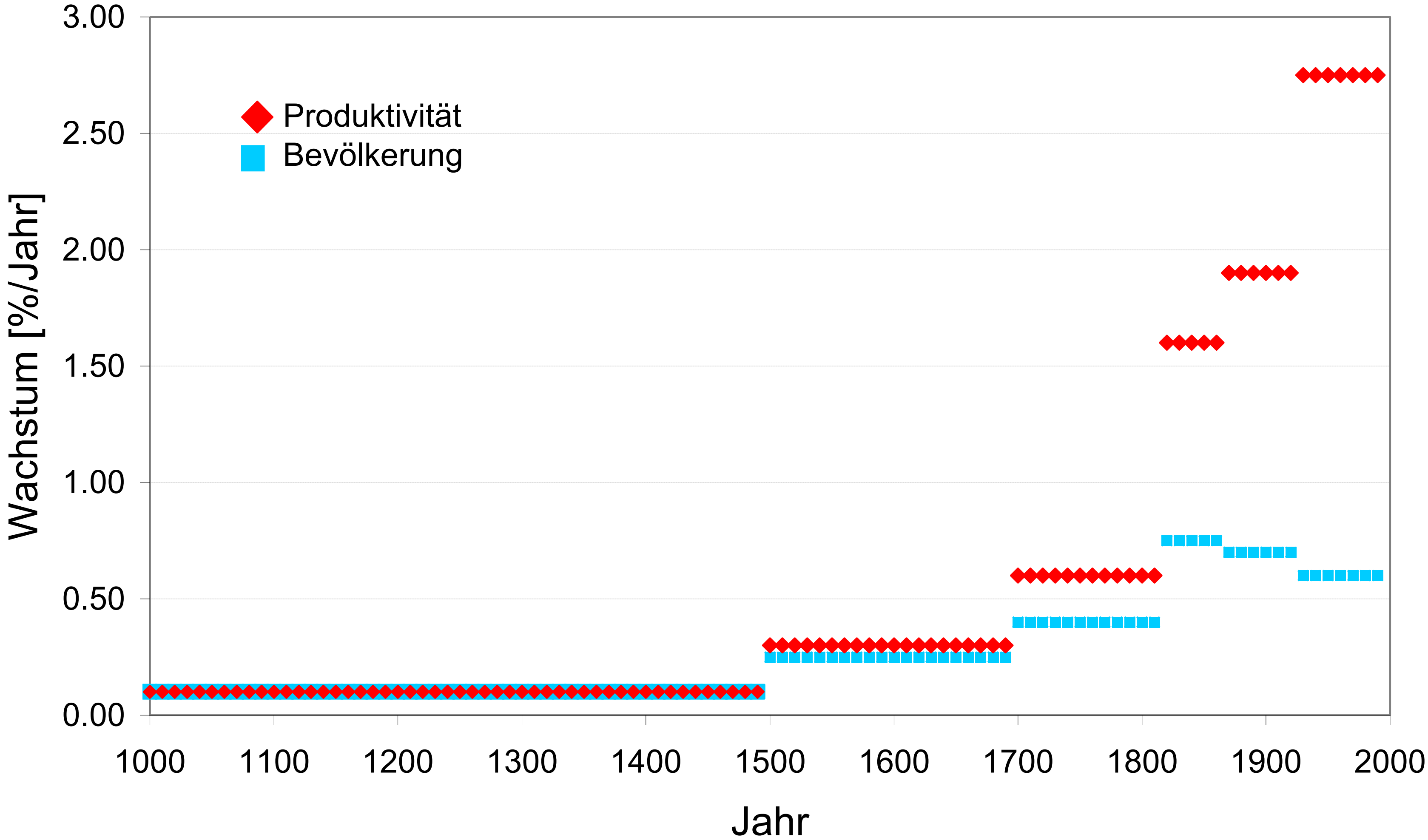
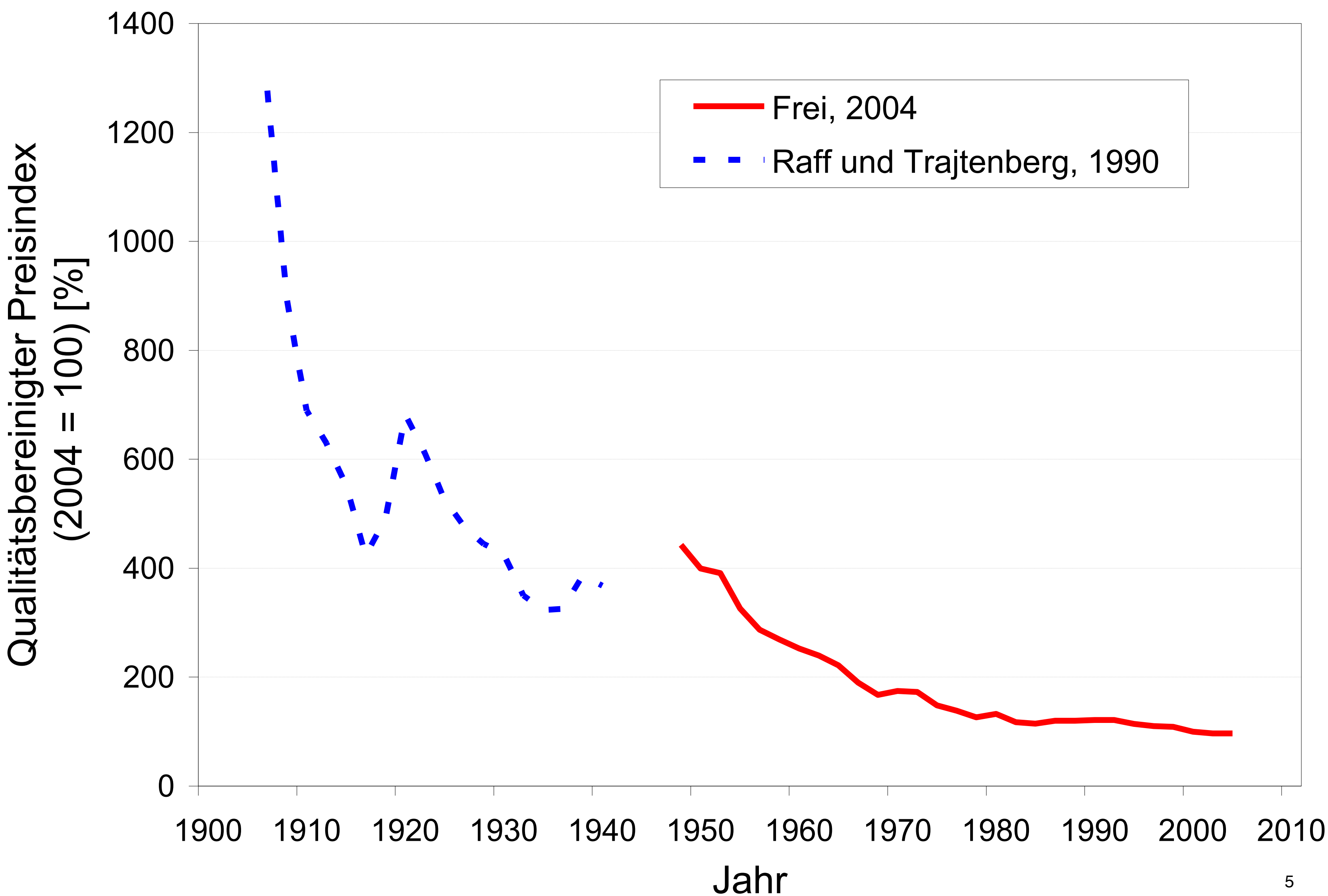
What are the trends ?

Productivity and population growth in Western Europe



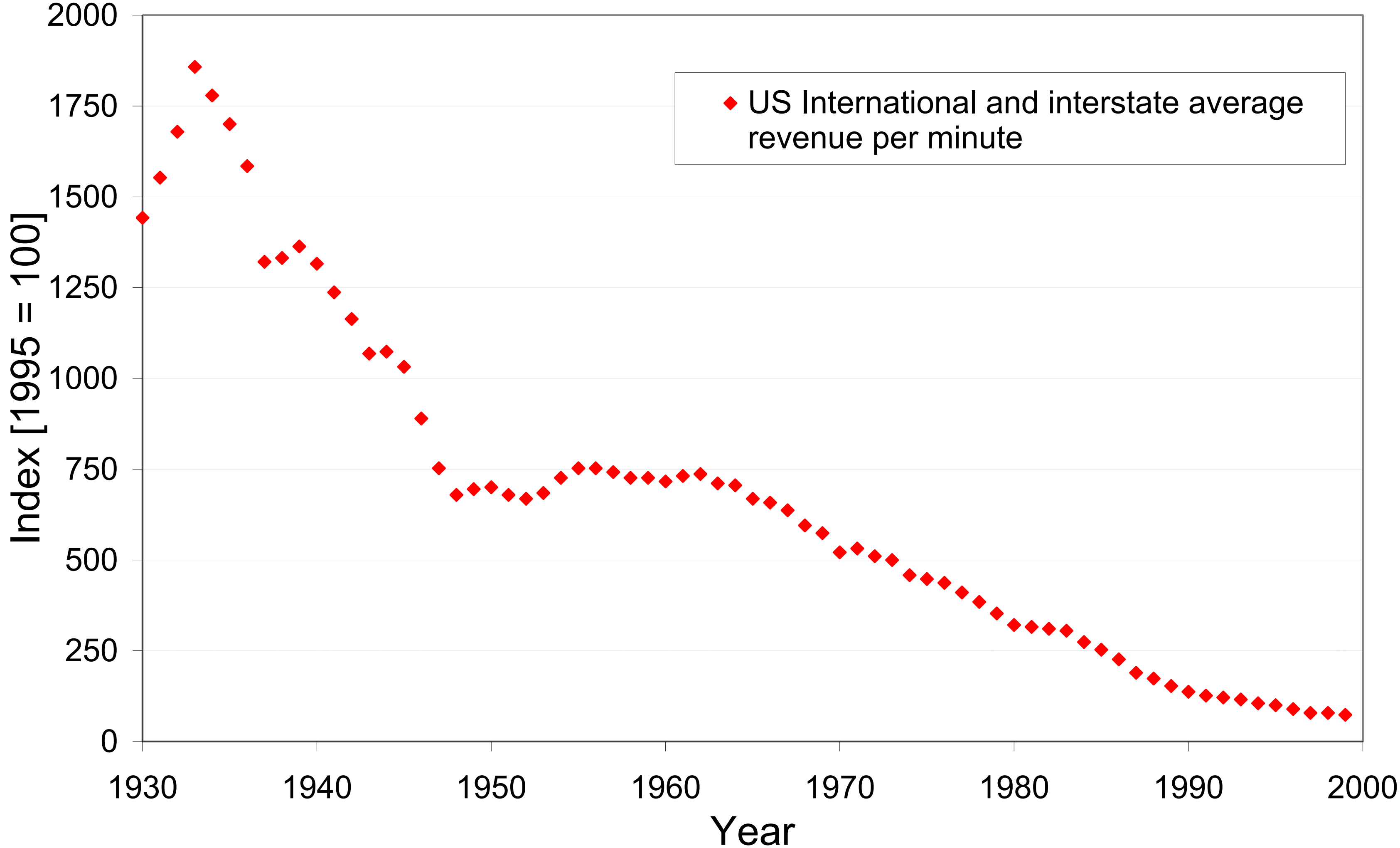
Galor and Weil (2000), Figure 1

Quality-adjusted price of a new car in Switzerland



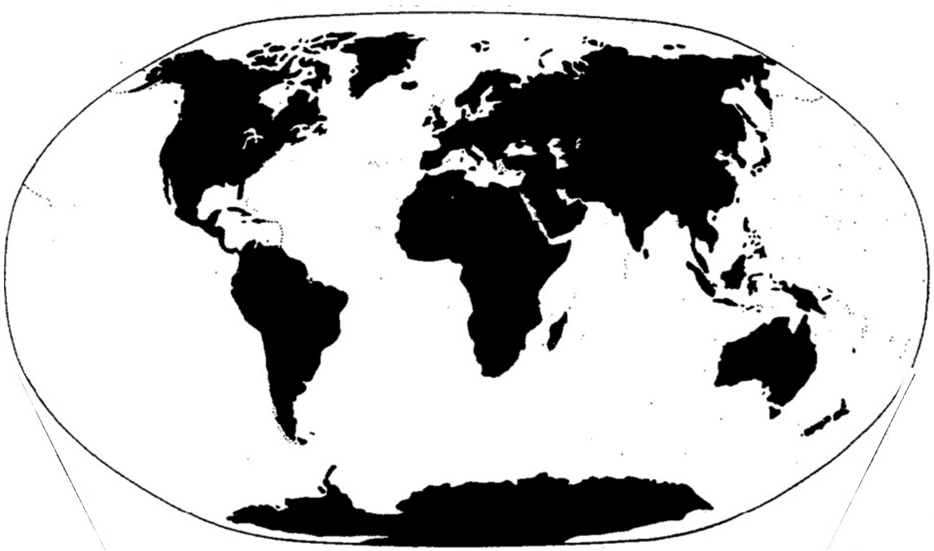
Frei, 2005

Price of telecommunication



Adapted from FCC (2001)

A shrinking world



Coach and sailing boat until 1840

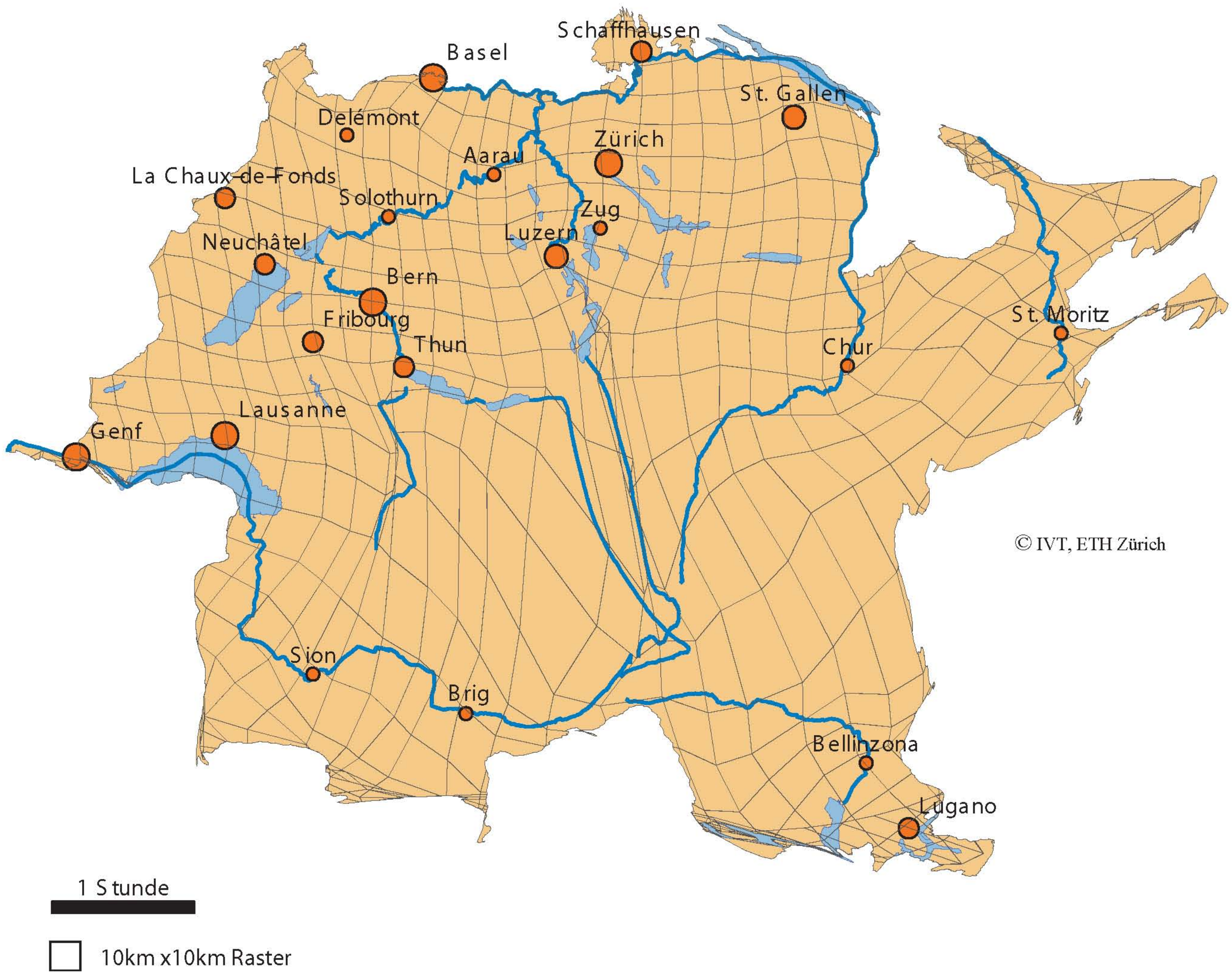
Steam ship and locomotive, 1840 - 1930

Propeller aircraft, 1930-1950

Jets, from 1950

Dicken, 1998

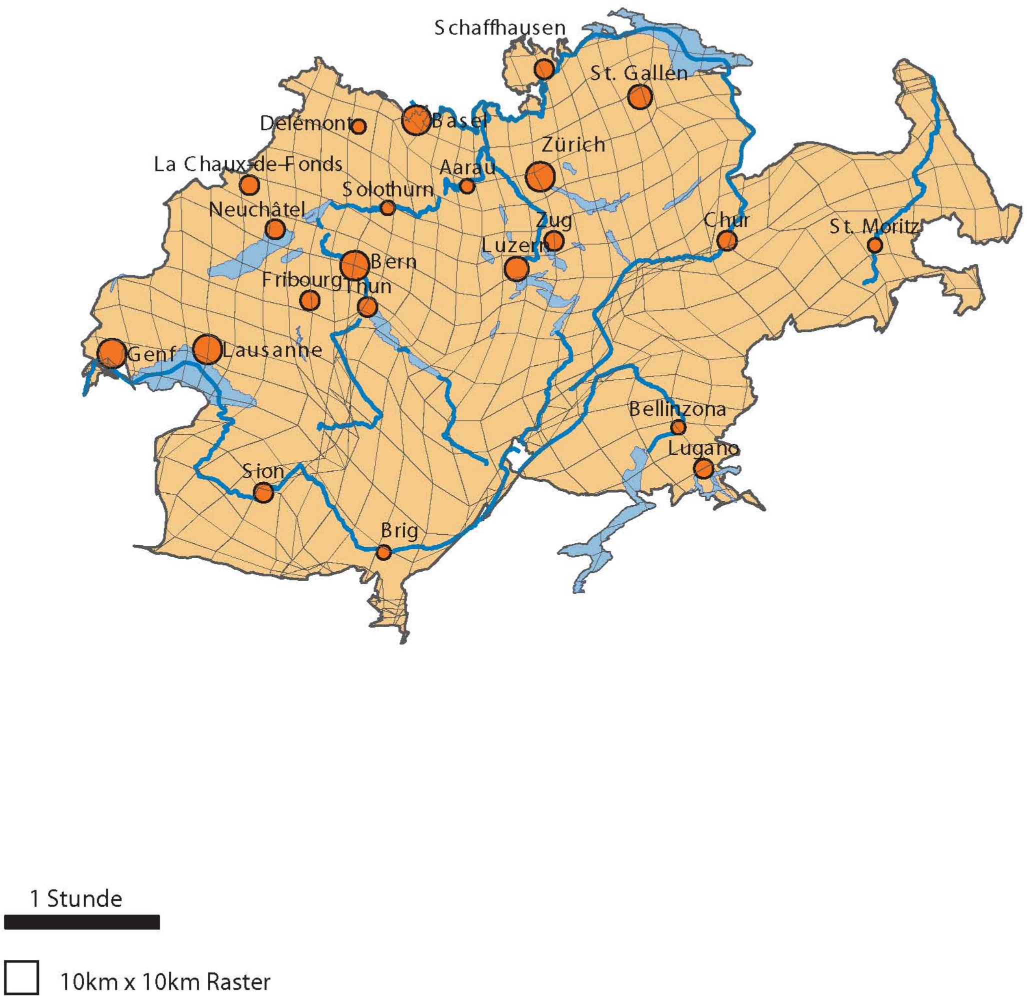
Shrinking “road” – Switzerland (1950)



Scherer, 2004

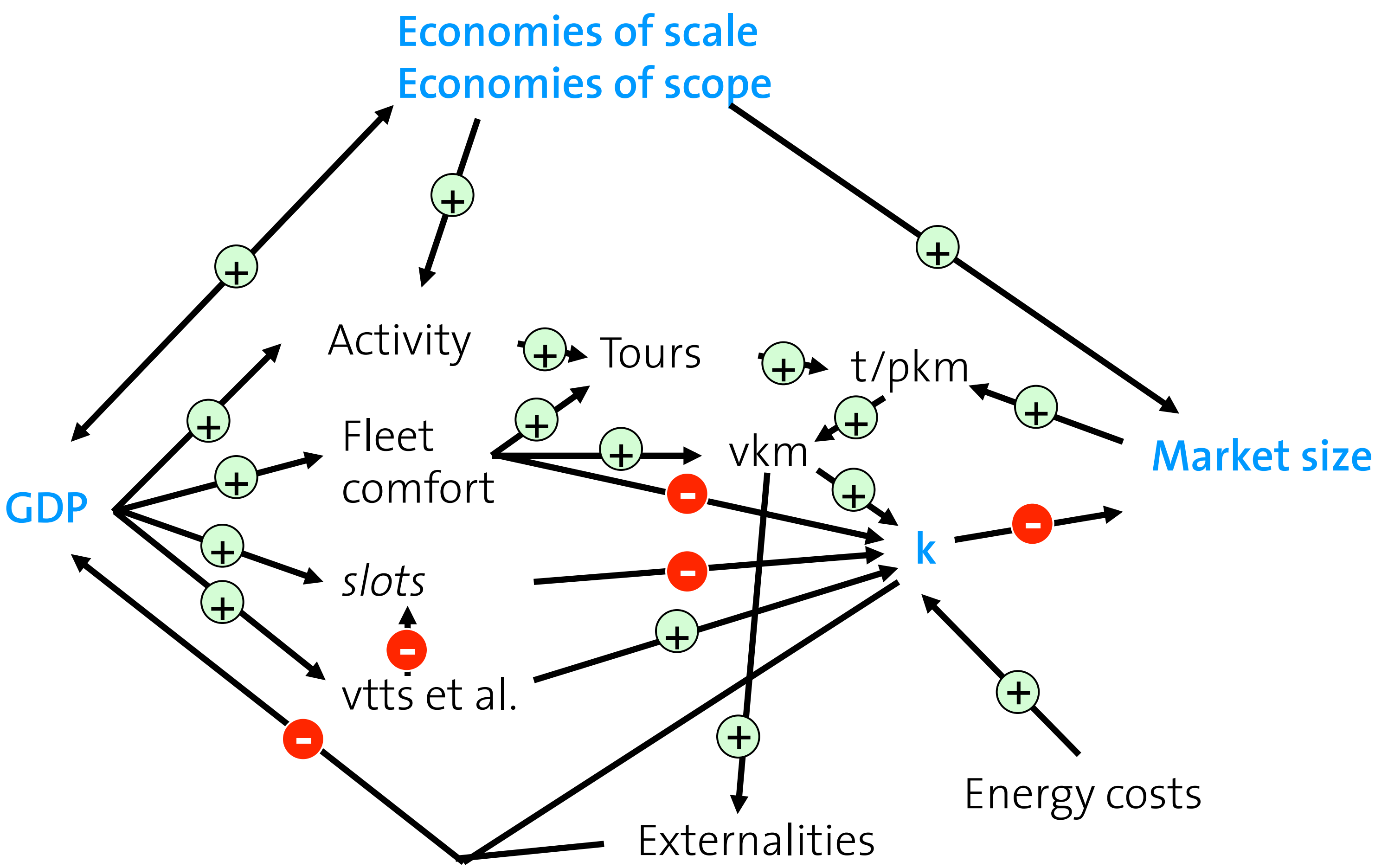
Stunde 1

Shrinking “road” Switzerland (2000)



Scherer, 2004

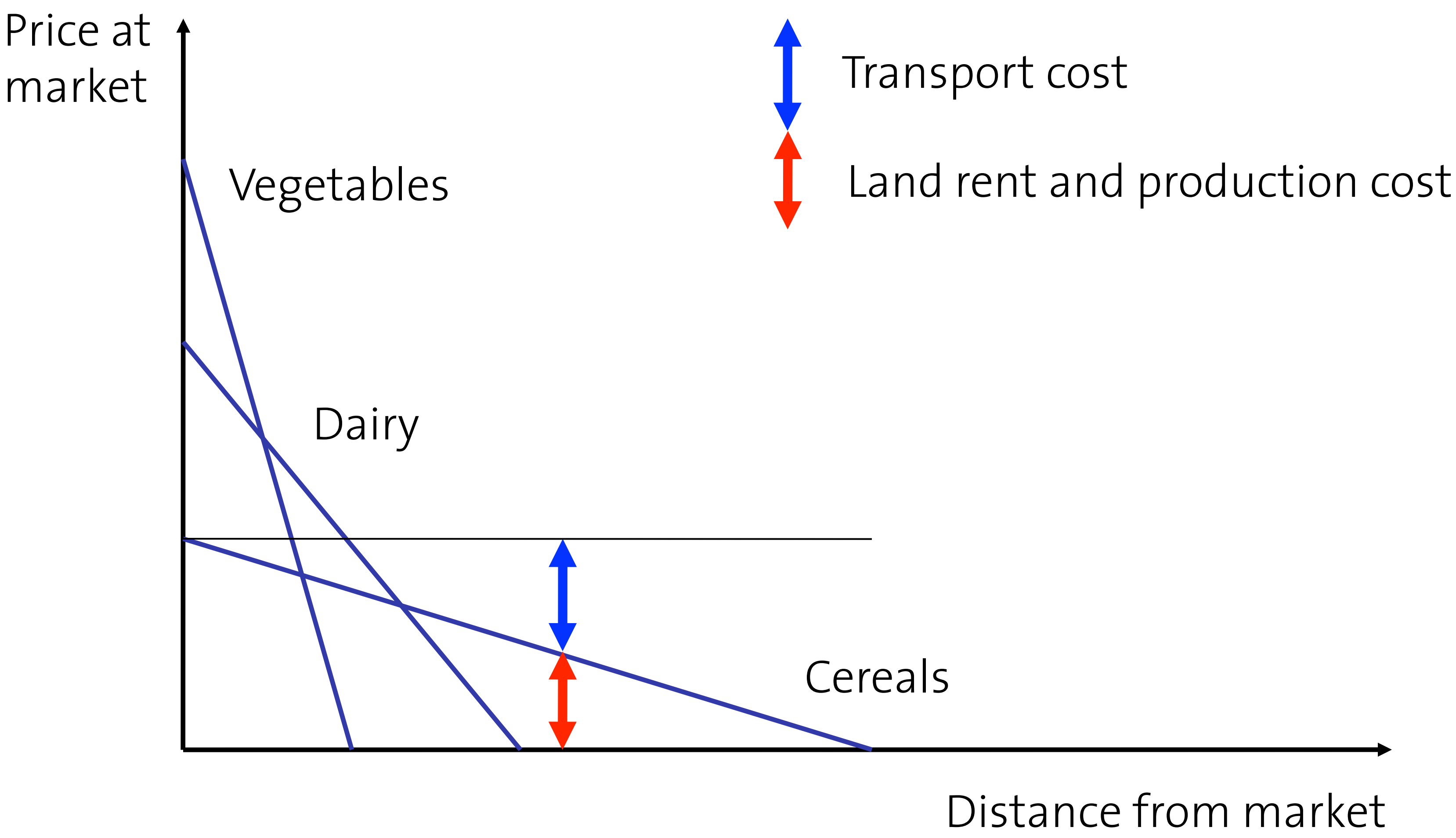
Size of goods markets and productivity: A hypothesis



+ Elasticity > 0
- Elasticity < 0

Slots: possibilities to move goods or people
For a given infrastructure and commercial
and private fleet

Von Thünen‘s model of land use for the isolated city



Based on Von Thünen (1910)

Short-term benefits and costs after an improvement

Public	Private	Firms	Land owners
	Lower travel times Higher reliability Smaller scheduled delays	Lower logistics costs	

Medium-term benefits and costs after an improvement

Public	Private	Firms	Land owners
Higher externalities Higher maintenance costs Higher transit subsities Larger fuel tax receipts	Mode choice change Higher VMT Larger selection More out-of-home activities Higher travel expenditures	Changed customer structure	Changed (higher) imissions

Long-term benefits and costs after an improvement

Public	Private	Firms	Land owners
More competition	New residential location	Better match of employees	Higher land prices
More innovation	Better job match	Higher productivy	
Higher growth	Higher incomes	More competition for employees and customers	
More social capital	Lower consumer prices		
	Lower transit supply		
	More stable social networks		

Recent Swiss estimates of demand elasticity

Indicator	**Elasticities w/r accessibilitity**	
	Short term	Long term
Share of out-of-home		0.61
Number of trips	0.37	0.44
Number of trips / journey	0.07	0.24
Time out-of-home	-0.23	0.10

Weis and Axhausen (2009, 2011)

Elasticity of productivity with respect to „mean distance“

Sector	Elasticity
Industry	0.070
Service	0.197
All	0.129

Soruce: Graham (2007)

Loosers

Firms:

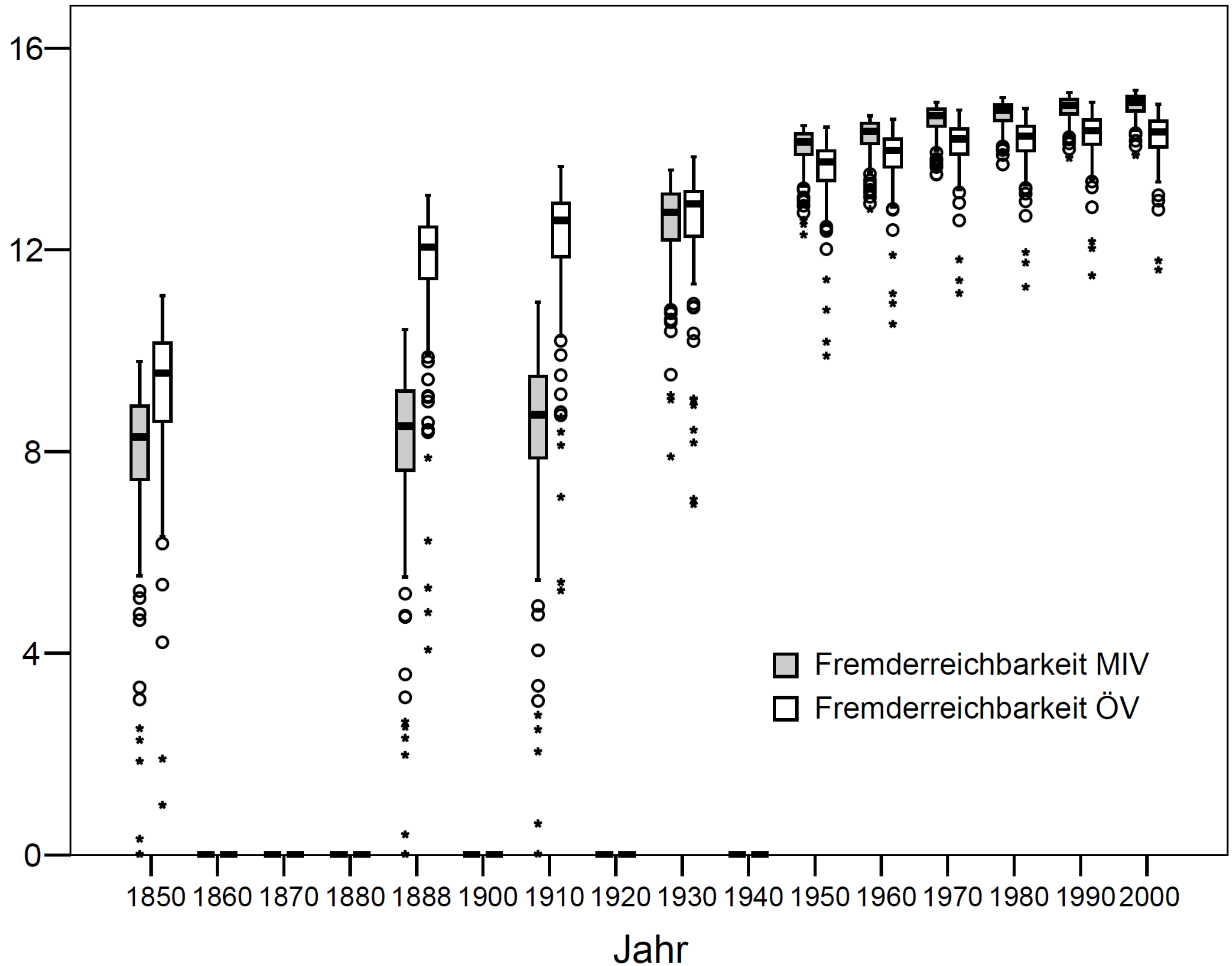
- Not enough capital/cash flow to expand/adapt
- Not enough expertise to innovate/adapt

Individuals:

- Not enough education to adapt
- Not enough savings/cash flow to adapt
- Not enough degrees of freedom to adapt

- Loss of “vicinity”
- Loss/increased generalised costs of the vehicle-less option

Accessibilities road and transit (Switzerland,1850 – 2000)



Axhausen, Fröhlich and Tschopp (i2011)

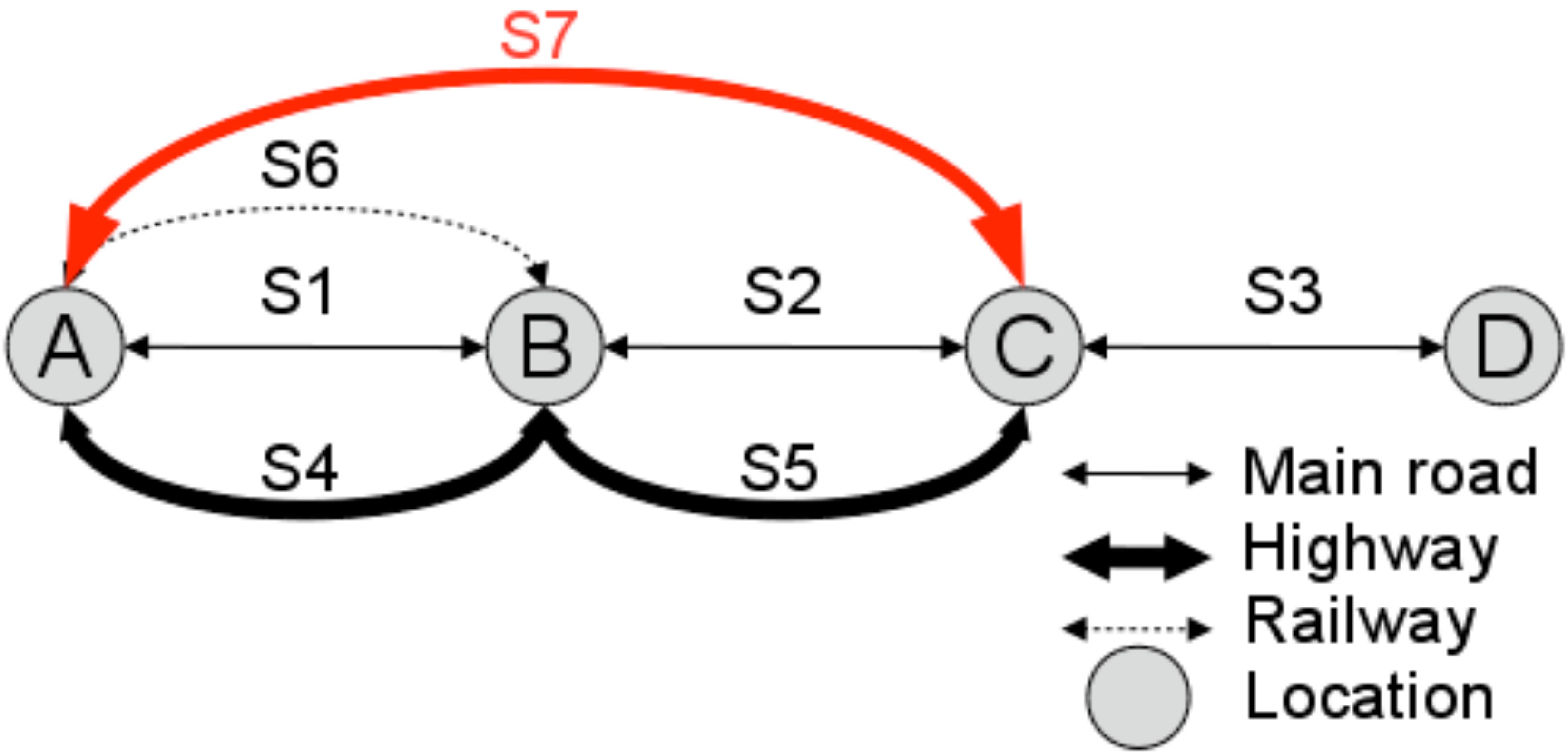
Research questions for MiniStadt: An agent-based model

- Can you capture the total benefits with travel time savings alone ?

- Construct the simplest necessary model
- Find plausible parameter set

- Experiment with various degrees of freedom of adaptation

MiniStadt: Form (including additional link S7)



MiniStadt: Choice dimensions

1000 agents returning home

- Work locations (1)
- Residential locations (3) with 600 homes each
- Time slots (24 of 5 minutes)
- Connections/routes (15/17)

MiniStadt: Utility formulation

Systematic utility of a connection:

$$V_r(r,t,j) = \beta_a T_r$$

Systematic utility of a departure time:

$$V_t(\tau) = \alpha\, SDE(\tau) + \gamma\, SDL(\tau) + \delta\, d_L$$

Systematic utility of a residential location:

$$V_d(j) = e^{\lambda \frac{A_j}{Q_j}}$$

MiniStadt: Experiments

Four experiments starting from RTD before equilibria:

- Connection (R)
- Connection * time (RT)
- Connection * destinations (RD)
- Connection * time * destinations (RTD)

MiniStadt: Occupancy rates

Experiment	B		C		D	
[%]	High	Low	High	Low	High	Low
RTD	76	8	9	59	0	15
RT	82	6	3	64	0	12
R	82	6	3	64	0	12
Before	82	6	3	64	0	12

Source: Zöllig and Axhausen, 2010

MiniStadt: Changes

	ΔRTD	ΔRT	ΔR
∑ Travel time [min]	-1187	-1647	-1505
∑ Travelled distance [km]	874	0	0
Accident costs [sFr/a]	-479’100	-472’700	-154’500
Traffic noise costs [sFr/a]	9’800	4’600	2’400
Air pollution costs [sFr/a]	26’500	13’600	7’200
Climate costs [sFr/a]	5’700	2’700	1’400

Source: Zöllig and Axhausen, 2010

MiniStadt: Utility gains

	ΔRTD	ΔRT	ΔR
ΔEMU	303	167	159
$\sum$ External costs	-437'100	-451'800	-143'400
ΔV_{routes}	69	111	103
ΔV_{time}	74	53	-15
$\Delta V_{destination}$	133	-	-
ΔRealised utility	276	165	87

Source: Zöllig and Axhausen, 2010

What next ?

- Enrich the models
    - Add time, location choice (and reliability impacts)
    - Build full land user transport models
- Add better estimates of productivity gains
- Adopt (monetarised) EMU as measure of user benefit
- Improve CBA practise (risk analysis, in particular)

More information at

www.ivt.ethz.ch

www.matsim.org

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Appendix

MiniStadt: Procedure

1. Load the initial conditions and set the number of iterations n = 0.
2. Calculate M, the number of agents deciding, as number of agents/(n + 1)2.
3. Sort the agents in descending order of their maximal potential utility gains.
4. Randomize the order of the M agents with the highest potential utility gains.
5. Let these agents decide one after the other and update the network after each decision.
6. Update the utilities across of all possible choices for all agents (choice set).
7. Calculate the maximal potential utility gain for each agent.
8. Calculate the system-wide statistics
9. Return to step 2 as long as $n < 20$ or sum of potential utility gains ≠ minimum of potential utility gains in the preceding iterations. Also stop iterating if no agent finds a better alternative, oscillation occurs, the maximum number of iterations is reached.

Ideal model: Short term model of activity scheduling

Number and type of activities
Sequence of activities

- Start and duration of activity
- Composition of the group undertaking the activity
- Expenditure division
- Location of the activity
    - Movement between sequential locations
        - Location of access and egress from the mean of transport
            - Parking type and location
        - Vehicle/means of transport
        - Route/service
        - Group travelling together
        - Expenditure division

Ideal model: Individual long(er) term choices

Social network geography

Social commitments

Amount and type(s) of occupation

- Working hours
- Work location(s)
- School location
- Home location

  - Mobility tools
  - Discount cards
  - Season tickets
  - Vehicles (by body type, fuel, energy efficiency)

Ideal model: Supply-side long(er) term choices

Network links and capacities

Housing

Office and factory space

Firm structure and size

- Logistics system choice
- Production technology and scale
- Public transport lines and service frequeny
  - Firm location(s)
  - Distribution channel(s)
  - Service points (stops and stations)
  - Prices

Cost-benefit analysis: SN 641 820 ff - benefits

Change in:

- Travel time
- Reliability
- User operating costs
- VAT income change of public transport firms

- Accidents
- Noise
- Emissions (local and global)
- Soil sealing
- External costs of energy use for infrastructure operations
- Landscape impacts