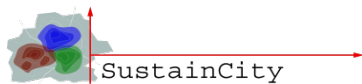# Preferred citation style for this presentation

Zöllig Renner, C., P. Schirmer and K. Müller (2013)

Case Study Zurich

presented at the *SustainCity Conference on Integrated Land-Use and Transport Simulation*, Zurich, April 2013.

Overview
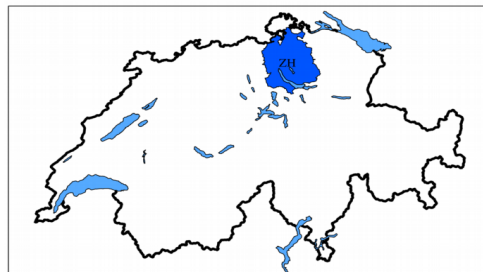
Source background image: GoogleEarth

Introduction – Simulation area and time period

Parcel level

Simulation start: 2000

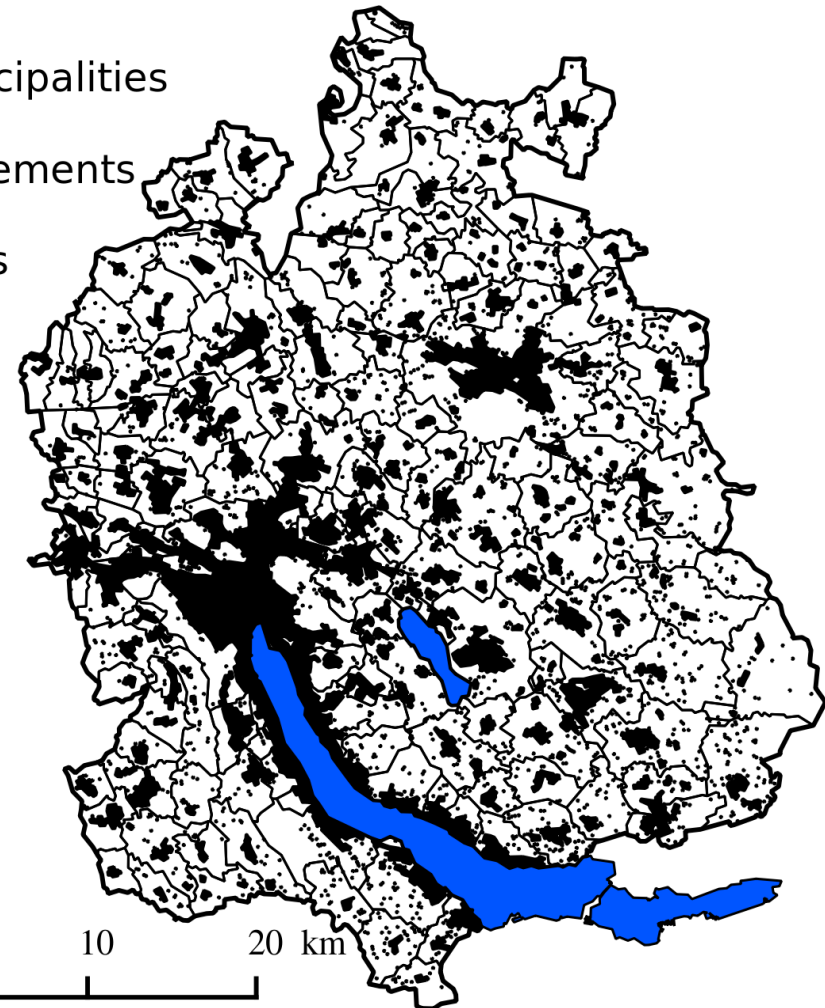Evaluation period: 2000-2010

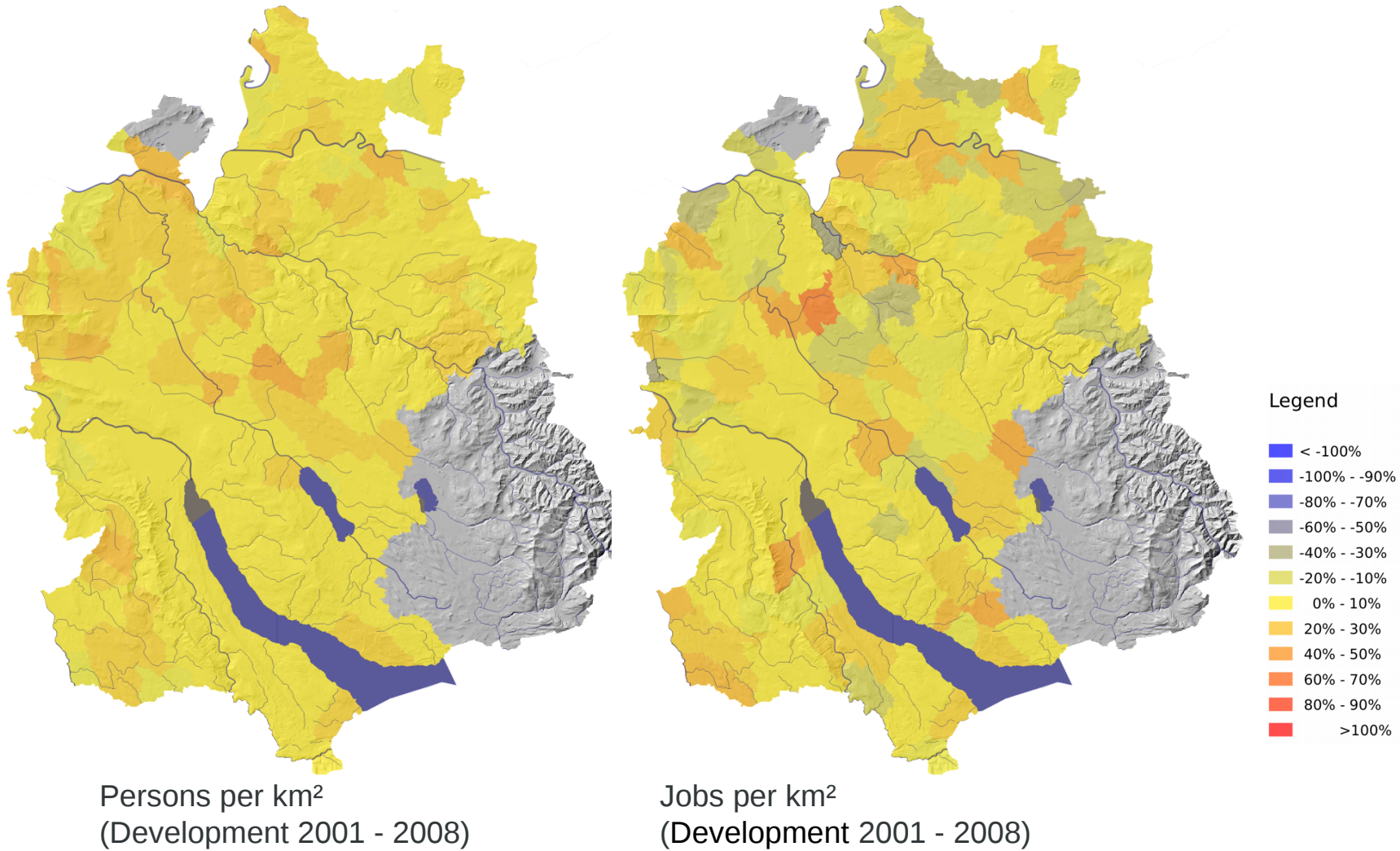(Simulation period: 2010-2030)

Municipalities

Settlements

Lakes

0   10   20 km

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Introduction

Persons per km²
(Development 2001 - 2008)

Jobs per km²
(Development 2001 - 2008)

Legend

- < -100%
- -100% - -90%
- -80% - -70%
- -60% - -50%
- -40% - -30%
- -20% - -10%
- 0% - 10%
- 20% - 30%
- 40% - 50%
- 60% - 70%
- 80% - 90%
- >100%

SustainCity Conference on
Integrated Land-Use and Transport Simulation, 18.04.2013

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Introduction – City of Zürich

- 370.000 inhabitants in 2007
- 180 vacant apartments = 0.09% of stock (01.07.2007)
- 46'551 persons moved into the city
- 42'108 persons have changed their residence within the city
- 2'263 new dwellings have been built
- 40'437 persons moved out of the city, 3'480 persons died

=> almost ⅓ of the population has moved!

Source: Thalmann (2010)
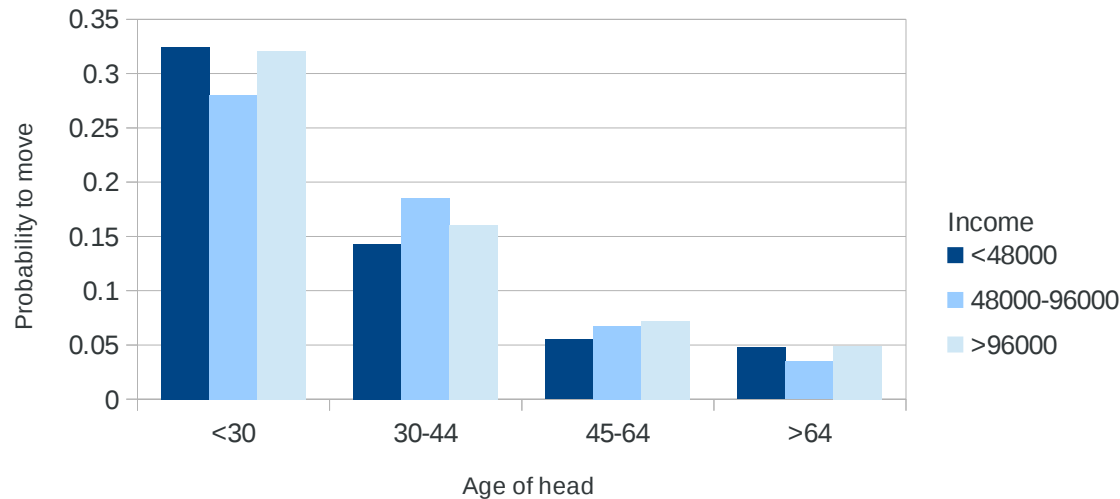
Overview

Major data sources

	Population census	(2000)
+	Register of buildings and dwellings	(2010)
+	Building insurance data	(2000)
+	Cadastral plans	(2005)
+	Enterprise census	(2001)
+	Transportation microcensus	(2005)
+	...	

==

= Base year data

Data processing

Editing

Vertical

- Aggregation
- Recoding

Horizontal

- Filtering
- Imputation

Linkage and matching

Deterministic

- Attribute/spatial join
- Record linkage

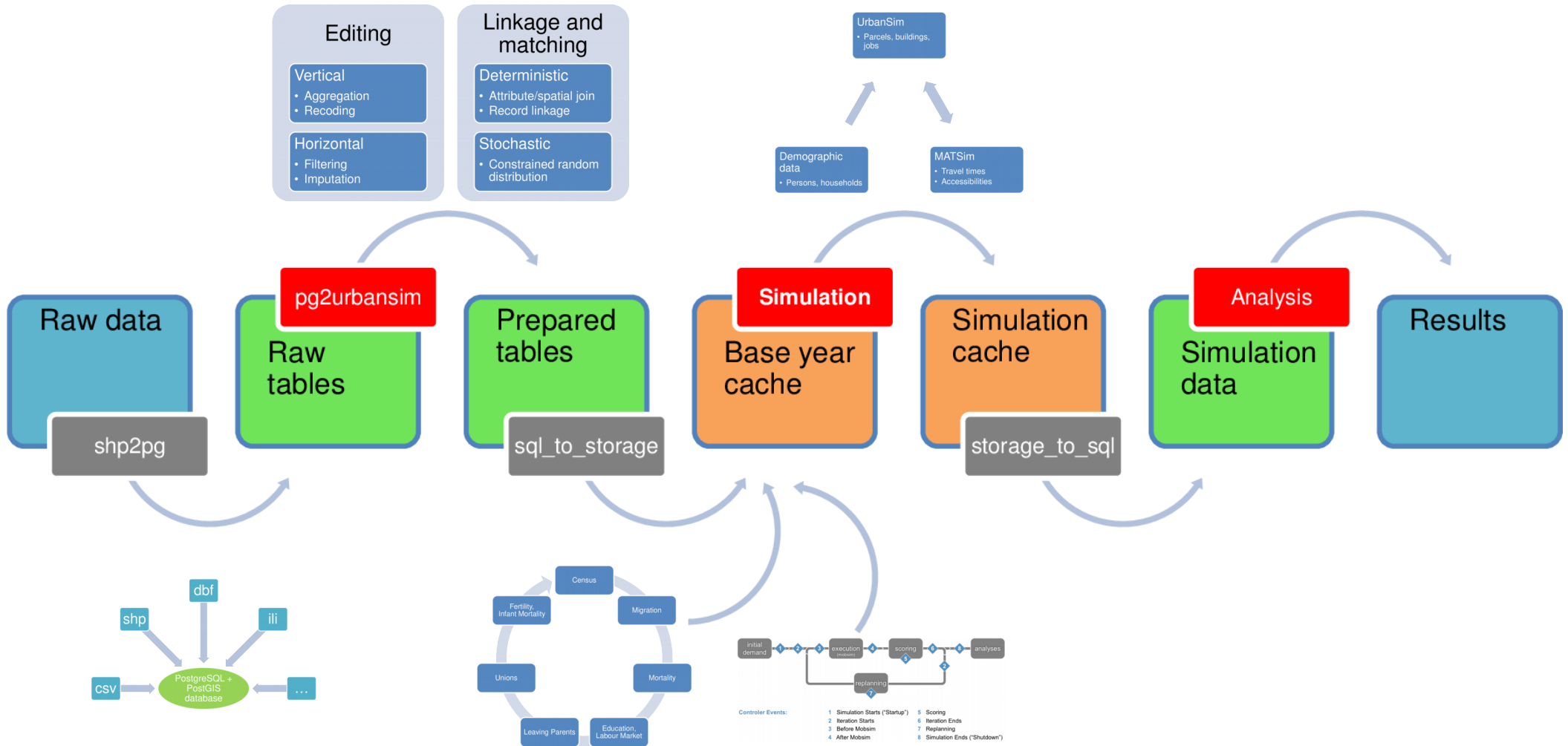### Stochastic

- Constrained random distribution

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SEVENTH FRAMEWORK
PROGRAMME

Funded under Socio-economic Sciences & Humanities
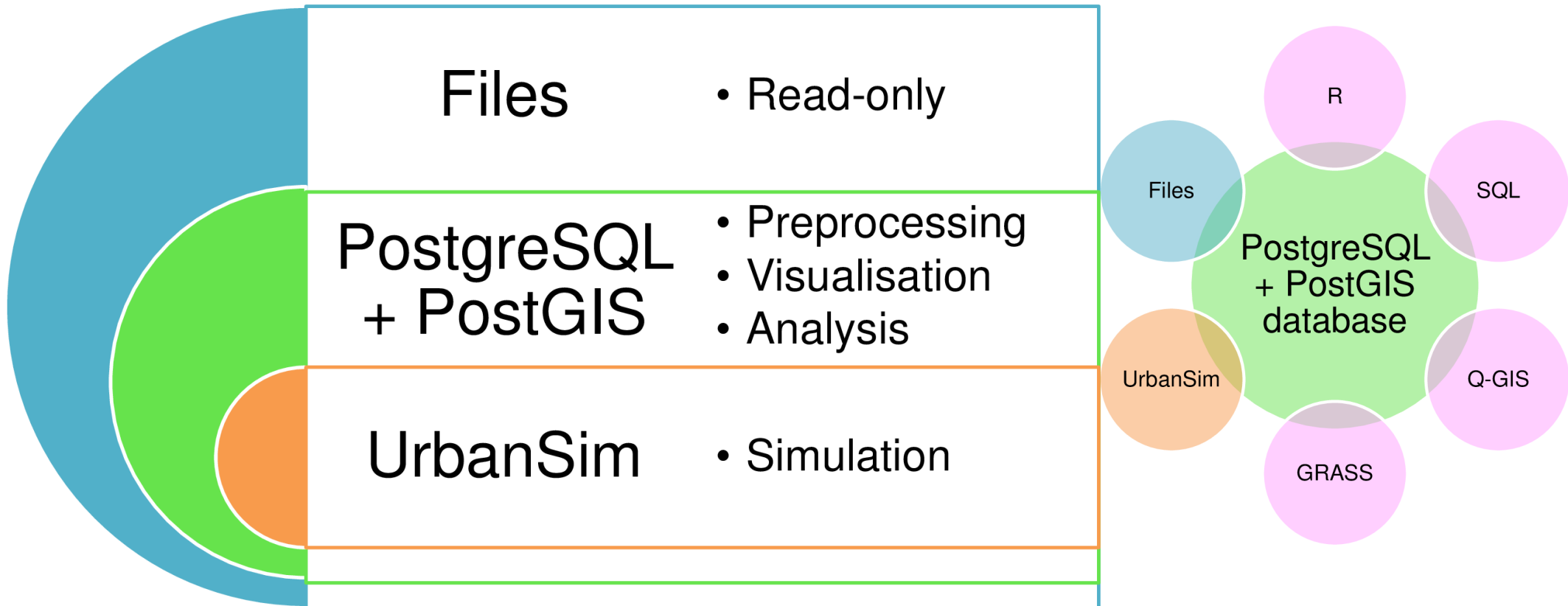
Data processing – spatial matching

● **GWR/GVZ**

Housing units

Construction year

Value

.....

■ **Soil coverage zones (A**V)

surface information

buildings footprints

.....

□ **Parcel**

size

FAR covered

.....

▭ **Land use zone**

planning constraints

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General structure of the data preparation

Data storage

Files	• Read-only
PostgreSQL + PostGIS	• Preprocessing • Visualisation • Analysis
UrbanSim	• Simulation

Data processing – import quality

Legend
av_gemeinden
- Not imported
- --
- -
- +
- ++

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Funded under Socio-economic Sciences & Humanities
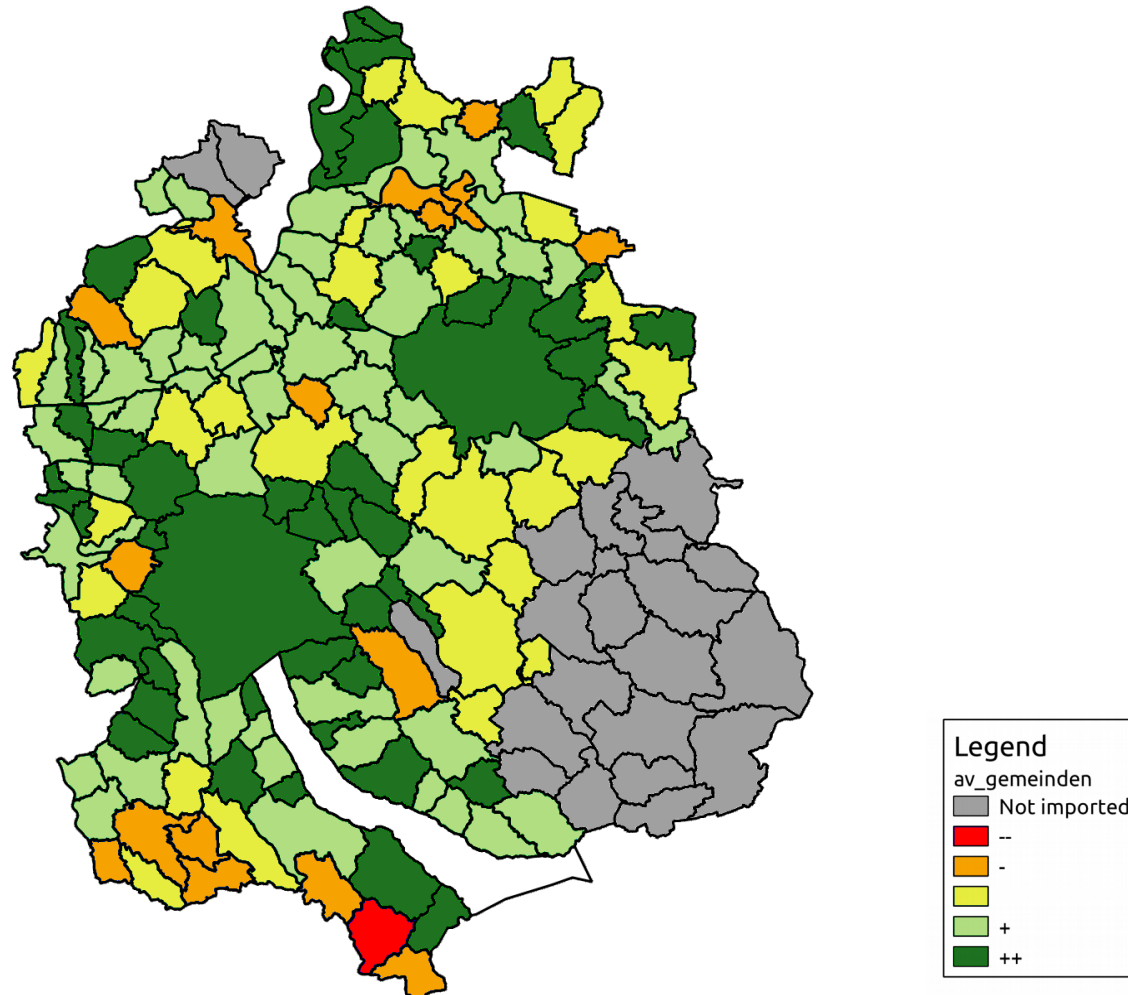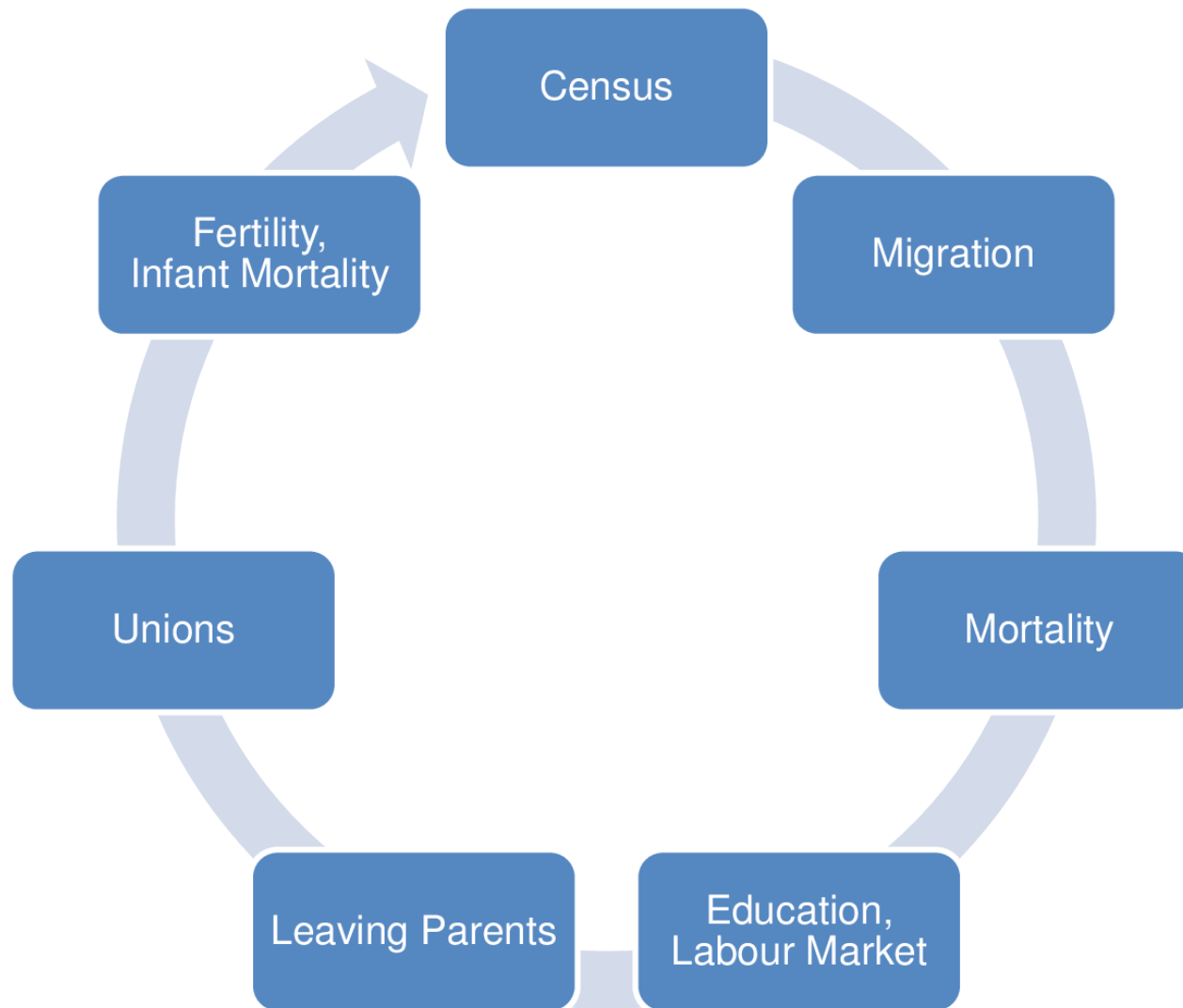
Demographic model

Calibration of demographic model

Population size

SustainCity
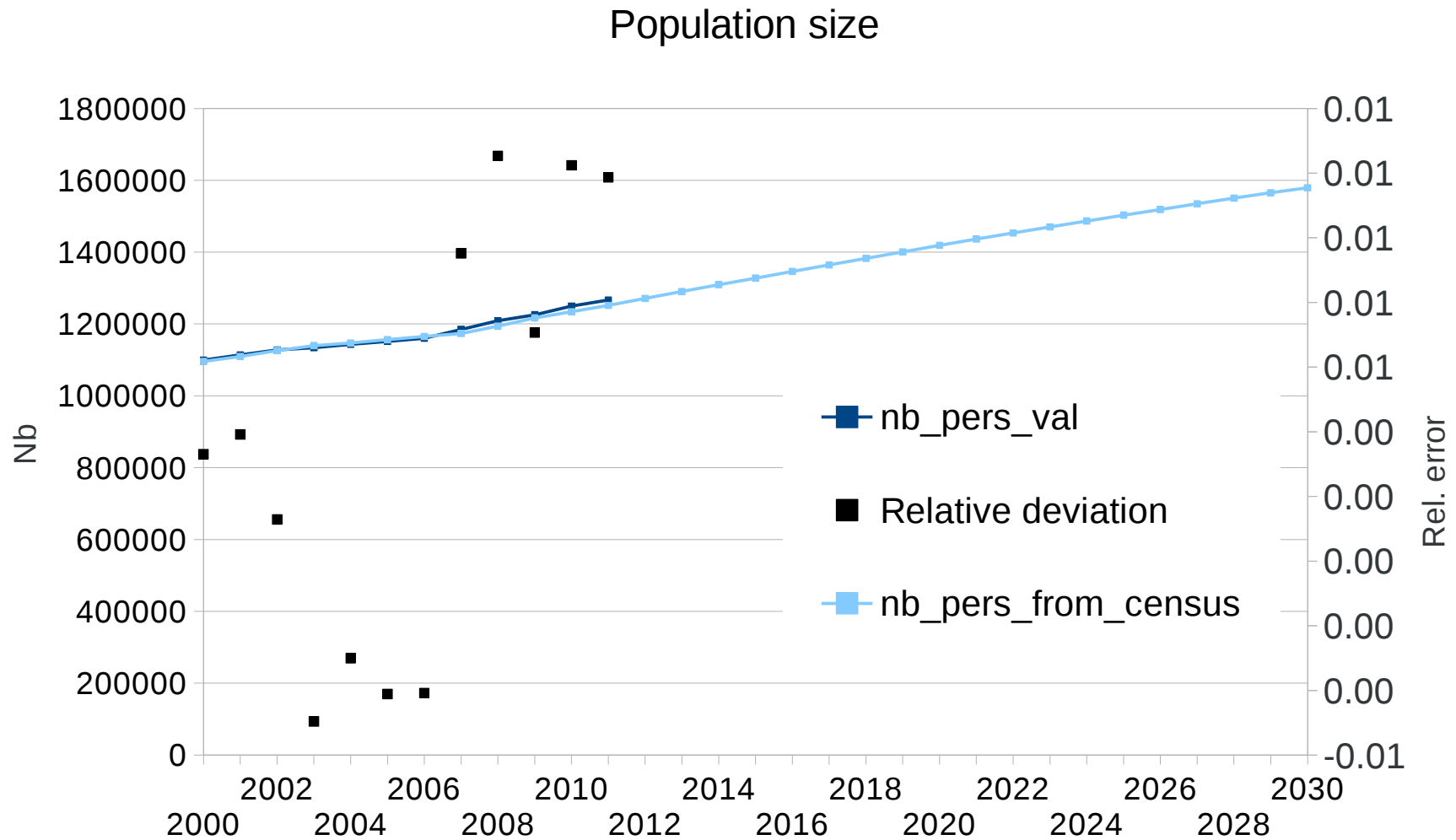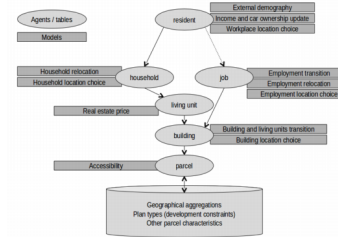
Overview

Context

Data processing

Modelling

Simulation

Findings

General structure of the model system
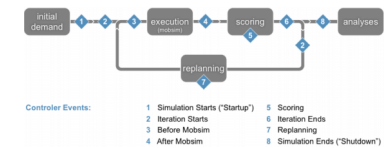
UrbanSim
- Parcels, buildings, jobs

Demographic data
- Persons, households

MATSim
- Travel times + modes
- Accessibilities

Car accessibility of hectare grid

Legend:
- [13,13.2)
- [13.2,13.4)
- [13.4,13.5)
- [13.5,13.7)
- [13.7,13.9)
- [13.9,14.1)
- [14.1,14.3)
- [14.3,14.5)
- [14.5,14.7)
- [14.7,14.8)
- [14.8,15)

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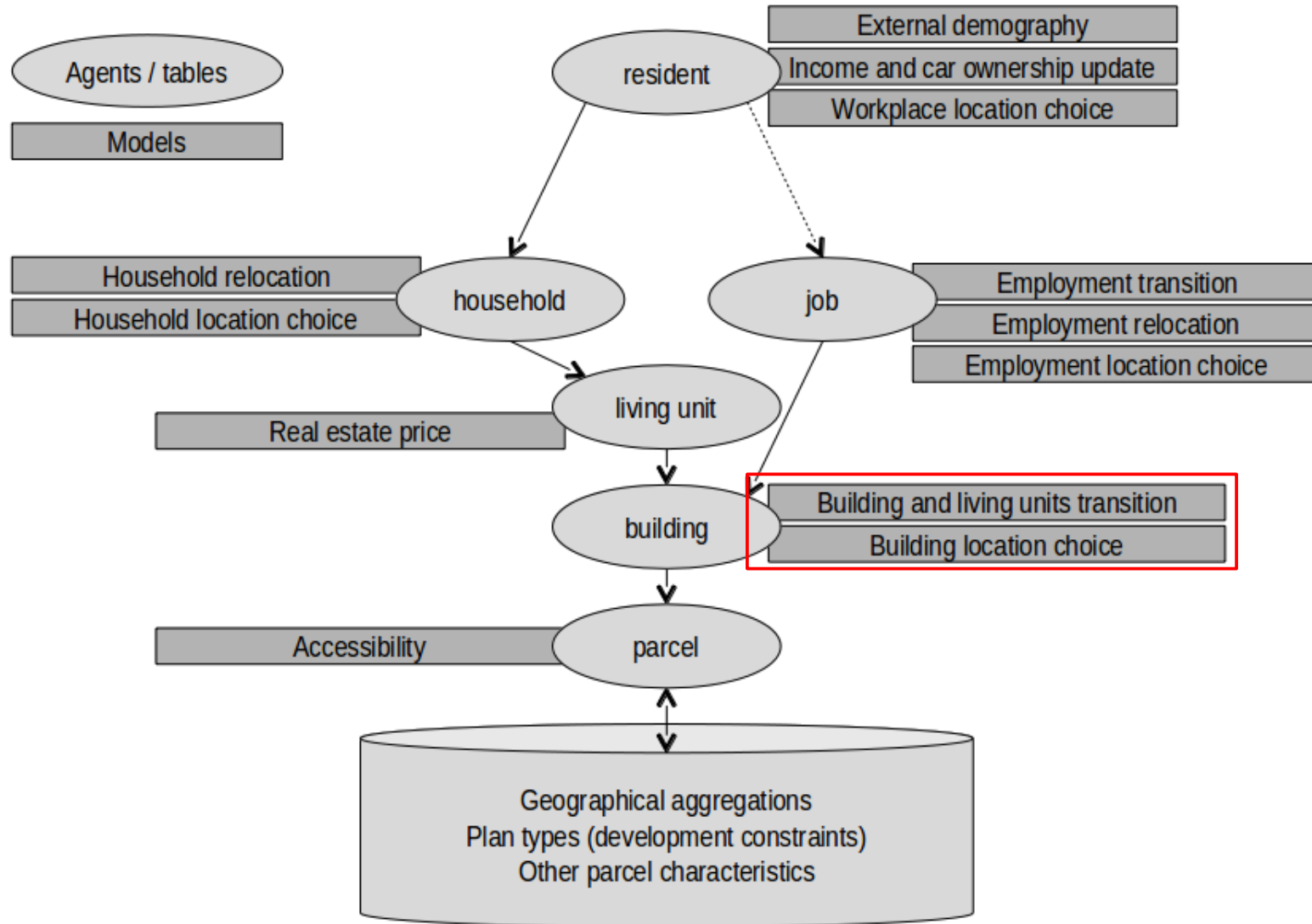
Run order of simulated models
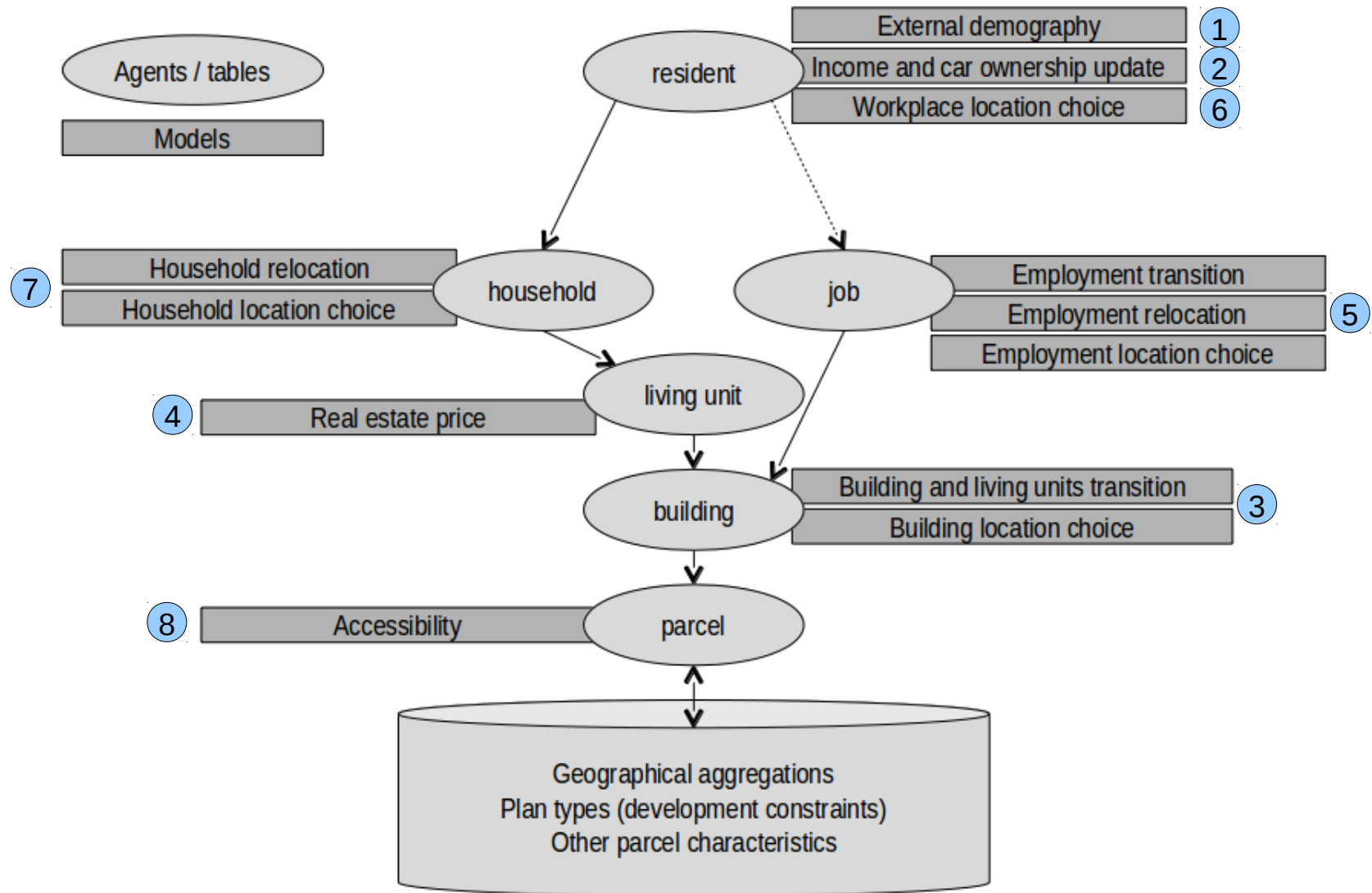
Models – Land development

SustainCity

Effect of variables

Parameter Name	Single Family Housing		Multi Family Housing		Mixed Use		Non-Residential	
	Effect	Sign.	Effect	Sign.	Effect	Sign.	Effect	Sign.
Car accessibility	-	***	-		-		+	***
PT accessibility	-		+	***	+	**	+	***
Fit of building to parcel	+	***	+	***	+	***	+	***
Distance to school	-	***						
New neighbouring buildings	+	***	+	***	+		+	***
Newcomers in neighbourhood	-	***	+	***			-	***
Price per permitted floor space	+	***	+	***	-	***	+	***
Slope	+	***	+				-	
Adj. likelihood ratio index	0.156		0.182		0.265		0.307	
Significance level	0.5%	***	1.0%	**				
Number of observations	523		445		65		114	
Total number of observations	1147							

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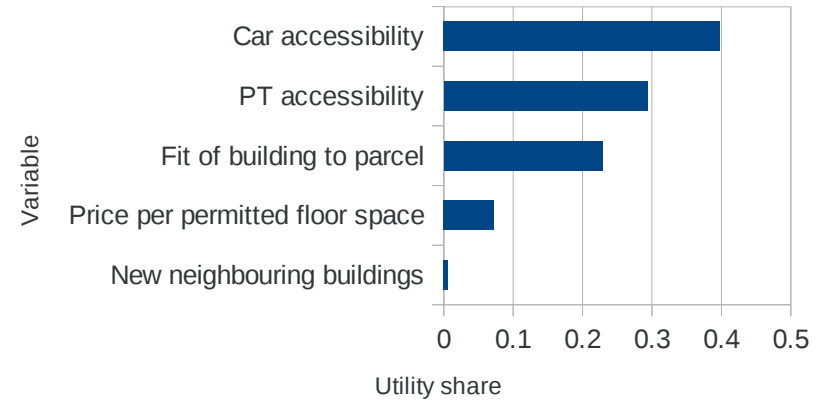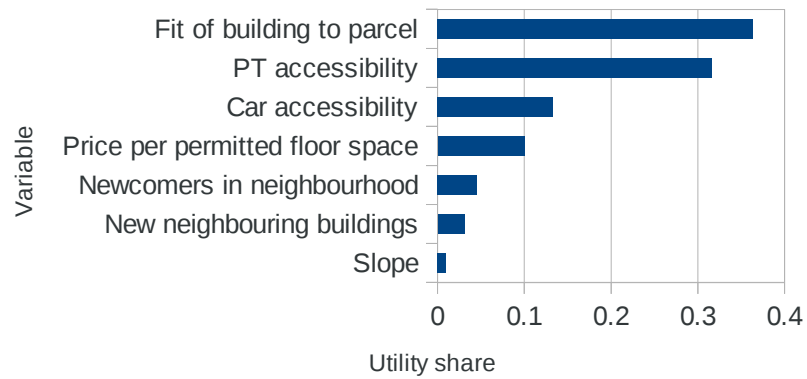
Impact of variables

Single Family Housing
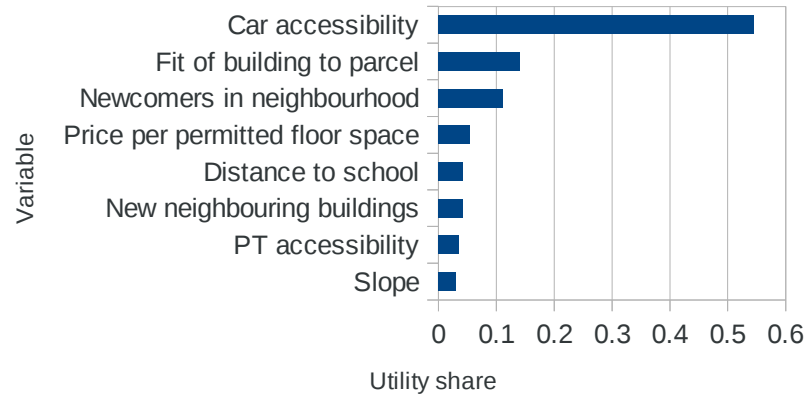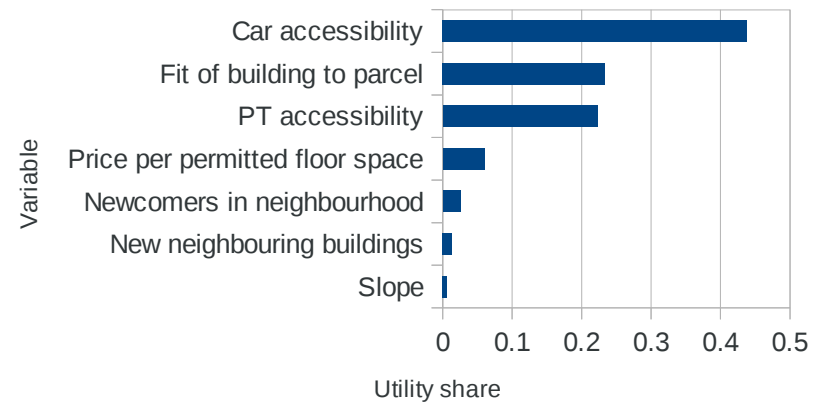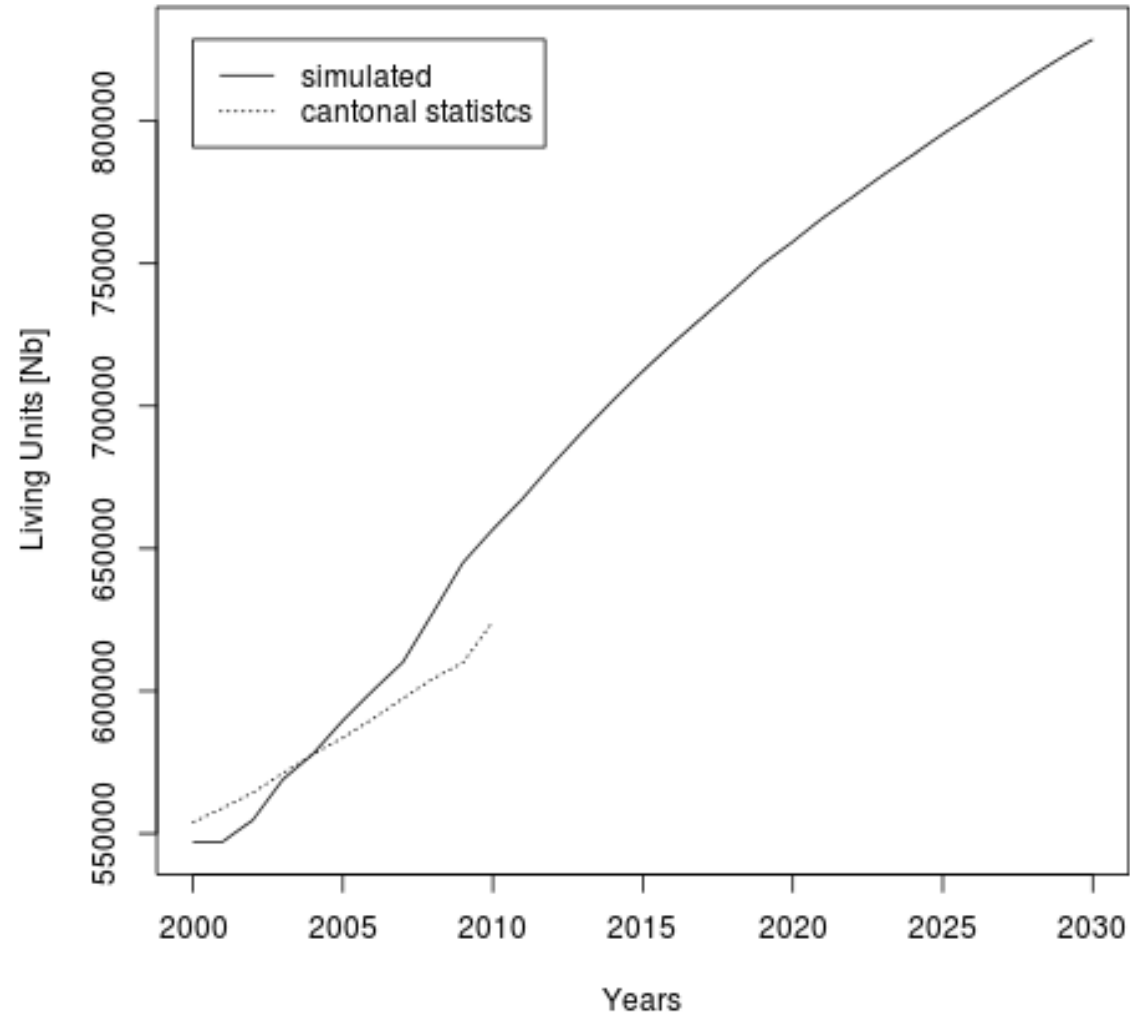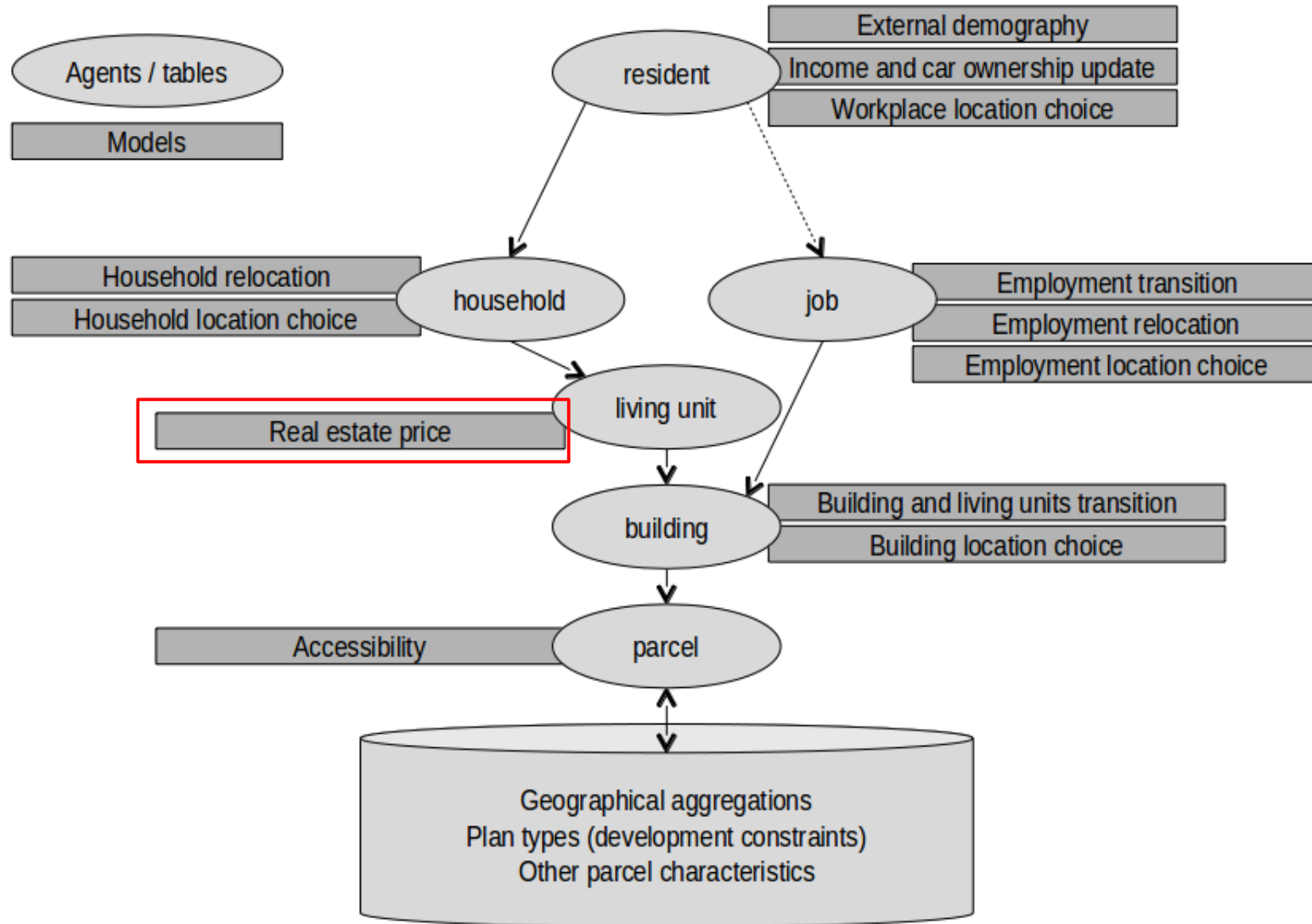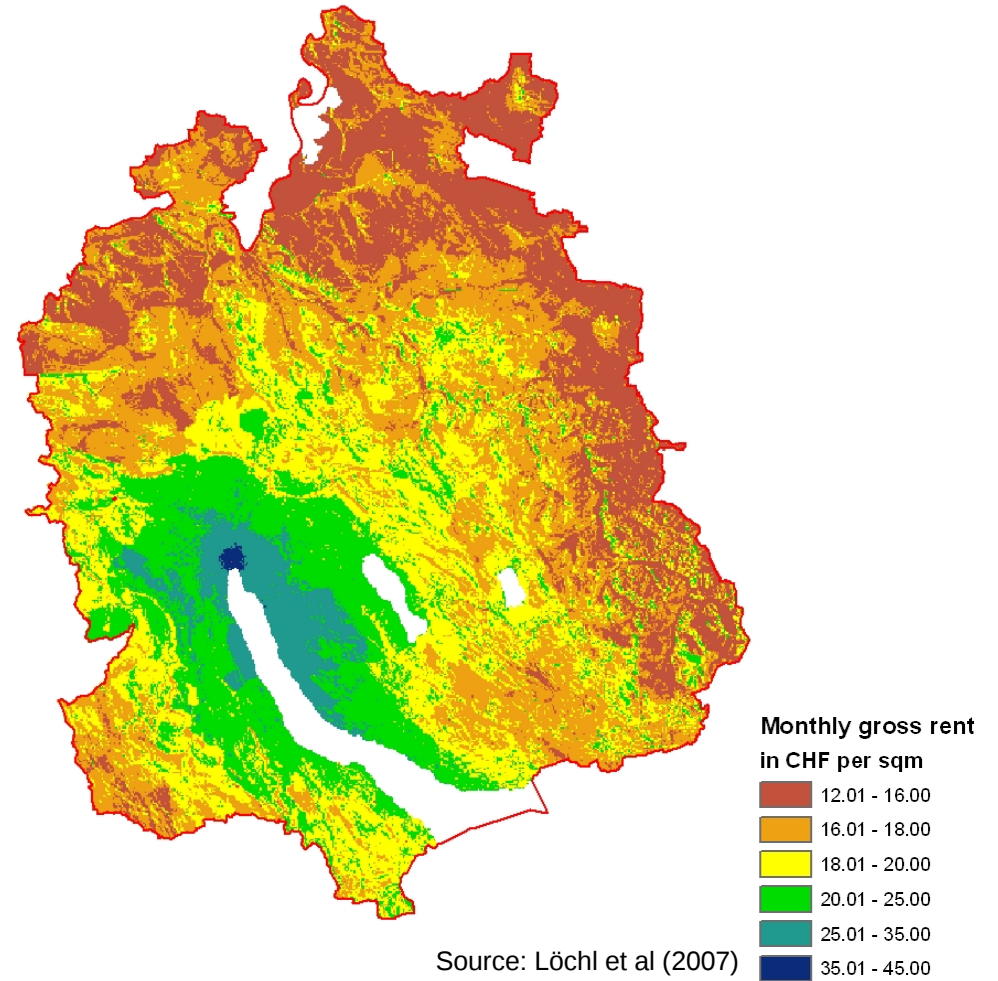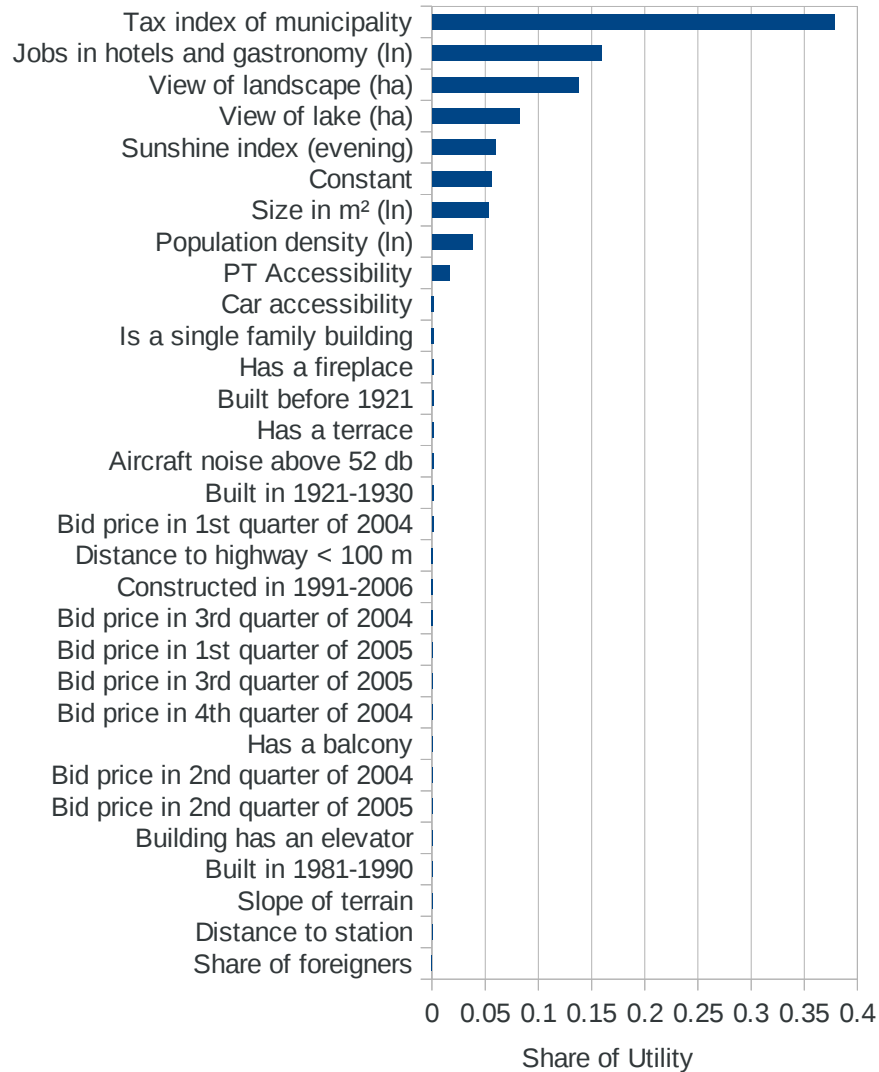
Mixed Use

Multiple Family Housing

Non-Residential

Creation of living units

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Models – Real estate price

Models – Real estate price

Bar chart — Share of Utility:

- Tax index of municipality
- Jobs in hotels and gastronomy (ln)
- View of landscape (ha)
- View of lake (ha)
- Sunshine index (evening)
- Constant
- Size in m² (ln)
- Population density (ln)
- PT Accessibility
- Car accessibility
- Is a single family building
- Has a fireplace
- Built before 1921
- Has a terrace
- Aircraft noise above 52 db
- Built in 1921-1930
- Bid price in 1st quarter of 2004
- Distance to highway < 100 m
- Constructed in 1991-2006
- Bid price in 3rd quarter of 2004
- Bid price in 1st quarter of 2005
- Bid price in 3rd quarter of 2005
- Bid price in 4th quarter of 2004
- Has a balcony
- Bid price in 2nd quarter of 2004
- Bid price in 2nd quarter of 2005
- Building has an elevator
- Built in 1981-1990
- Slope of terrain
- Distance to station
- Share of foreigners

X-axis: 0, 0.05, 0.1, 0.15, 0.2, 0.25, 0.3, 0.35, 0.4 — Share of Utility

Monthly gross rent in CHF per sqm
- 12.01 - 16.00
- 16.01 - 18.00
- 18.01 - 20.00
- 20.01 - 25.00
- 25.01 - 35.00
- 35.01 - 45.00

Source: Löchl et al (2007)

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Models – Real estate price

	UrbanSim		Löchl (2007)	
	Effect	Sign.	Effect	Sign.
Constant	+	**	+	**
Car accessibility	+	**	n.a.	n.a.
PT accessibility	+	**	+	**
Built in 1921 to 1930	+	**	+	**
Built in 1981 to 1990	+		+	**
Built after 1991	+	**	+	**
Built before 1921	+	**	+	**
Distance to station	-	**	-	**
Proximity to highway (< 100 m)	-	**	-	**
Is a single family house	+	**	+	**
Jobs in hotels and gastronomy	+	**	+	**
View of lake (ha)	+	**	+	**
Population density (ln)	-	**	-	**
Size in m² (ln)	+	**	+	**
Slope of terrain	+	**	+	**
Sunshine index (evening)	+	**	+	**
Foreigners within 300 m	+	**	(-)	(**)
Adj. Likelihood ratio index:	0.78173		0.85	
Number of observations:	6497		8592	

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Models – Employment

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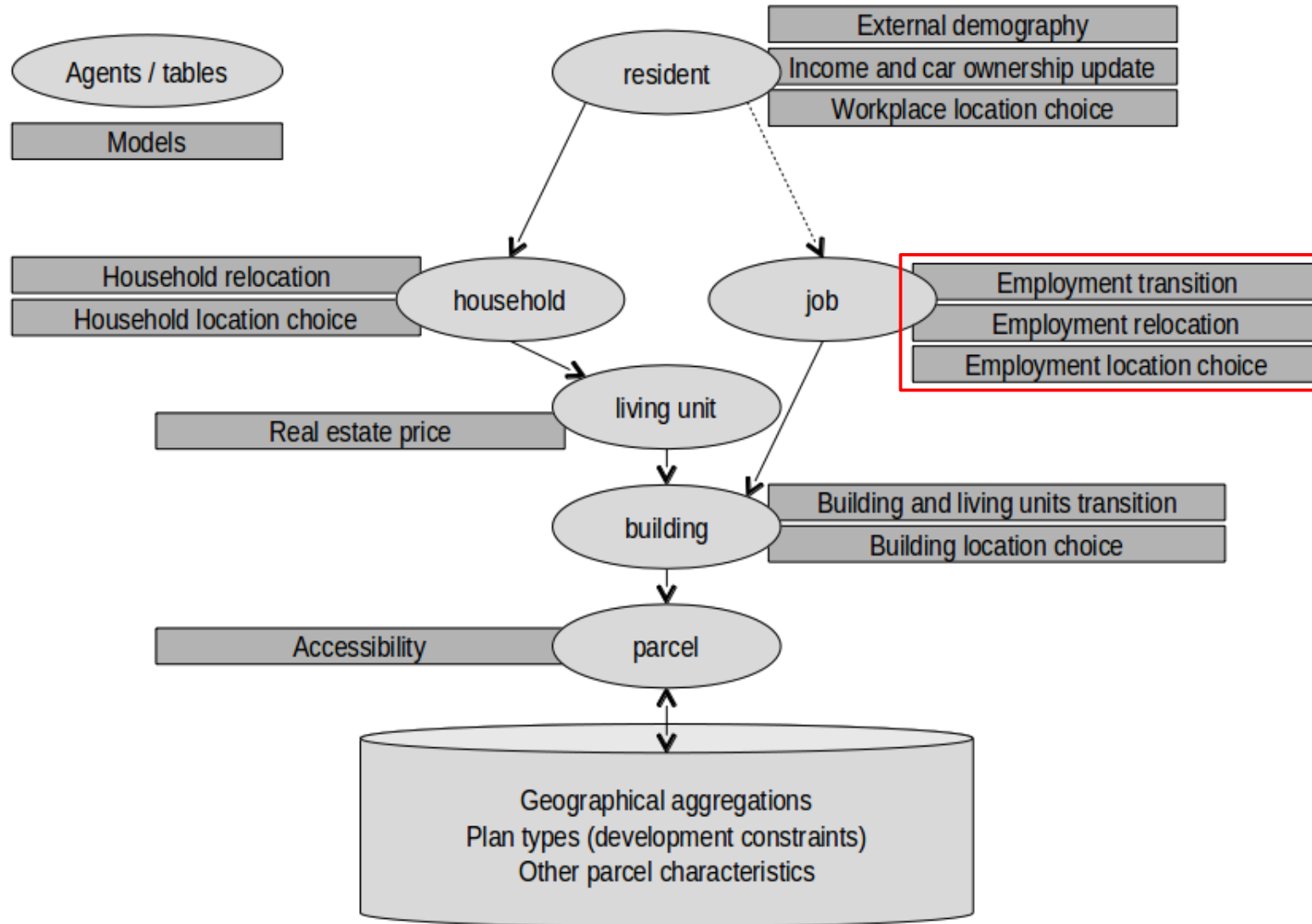
Models – Employment transition

Validation: Number of Jobs

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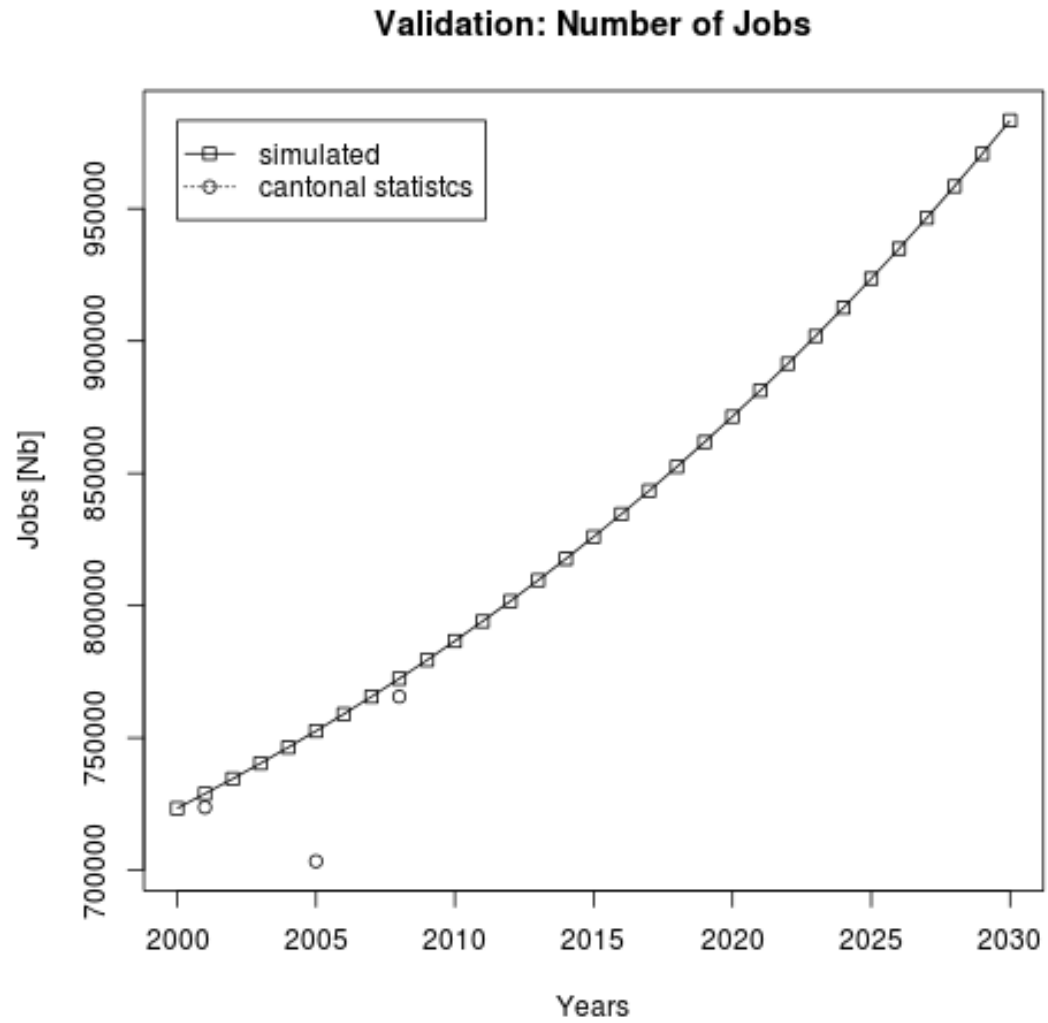
Models – Employment relocation

Moving behaviour of enterprises in St.Gallen and Appenzell

Source: Bodenmann (2012)
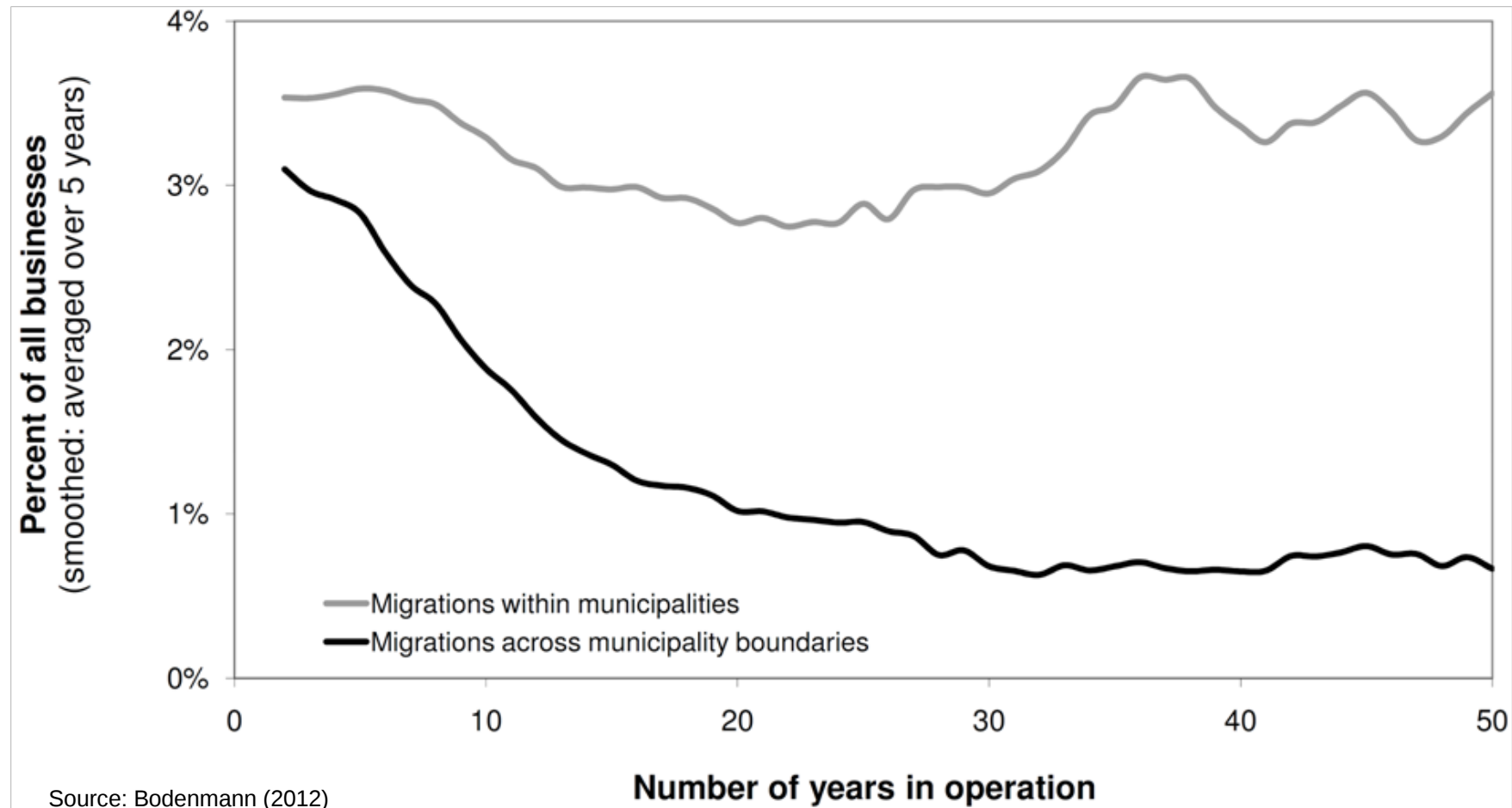
Models – Employment location choice

Observation of movers

all	Parameter	Manu-fact.	Whole- sale	Bus. service	Pers. service
1*	Alternative is a city	3*	2*	2*	1*
2*	Cantonal business development	2*	3*	3*	2*
3*	Tax burden for joint stock comp.	4*	4*	4*	4
4	Previous site is in a city	1*	1	1*	8
5*	Municipality with a rail connection	6*	5*	8*	3*
6*	Index of diversity in sectors	5*	9*	5*	11
7*	Population with graduate degree	8*	14*	5*	14
8*	Highway connection	10*	6*	9*	6
9*	Tax burden for partnerships	7*	8*	7*	10
10*	Accessibility to employees	9*	10*	10*	5*
…	…	.	.	.	.
18	Land price for commerce	17	18	18	16

* Sigificant according to t-test

NL-Modell, observations: 10'700, LL(0): -51'400, LL(max) -31'200, Adj. Rho-square 0.392

Source: Bodenmann (2012)

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Models – Employment location choice

Type	1	2	3	4	5	6	7	8
Average zonal income	– **	– **	– **	– **	– **	– **	– **	– **
Car accessibility	+ **	+ **	+ **	+ **	+ **	+ **	+ **	+ **
PT accessibility	+ **	+ **	+ **	+ **	+	+	+ **	+
Distance to motorway access	– **	– **	– **	– *	+	– **	+ **	+ **
Distance to station	– **	– **	– **	– **	– **	– **	– **	– **
Distance to Zürich CBD	+ **	+	+ **	+ **	+	+ **	–	– **
Household density (km²)	– **	– **	– **	– **	– **	– **	– **	– **
Job density (km²)	+ **	+ **	+ **	+ **	+ **	+ **	+ **	+ **
Share of same jobs (zone)	+ **	+ **	+ **	+ **	+ **	+ **	+ **	+ **
Adj. likelihood ratio index:	0.17	0.11	0.23	0.18	0.13	0.26	0.21	0.17
Number of observations:	15714	9187	11895	10143	7038	14390	33170	12382

Type 1 = Manufacturing (NOGA code C - E)
Type 2 = Construction (NOGA code F)
Type 3 = Wholesale Trade (NOGA code G 45, G46)
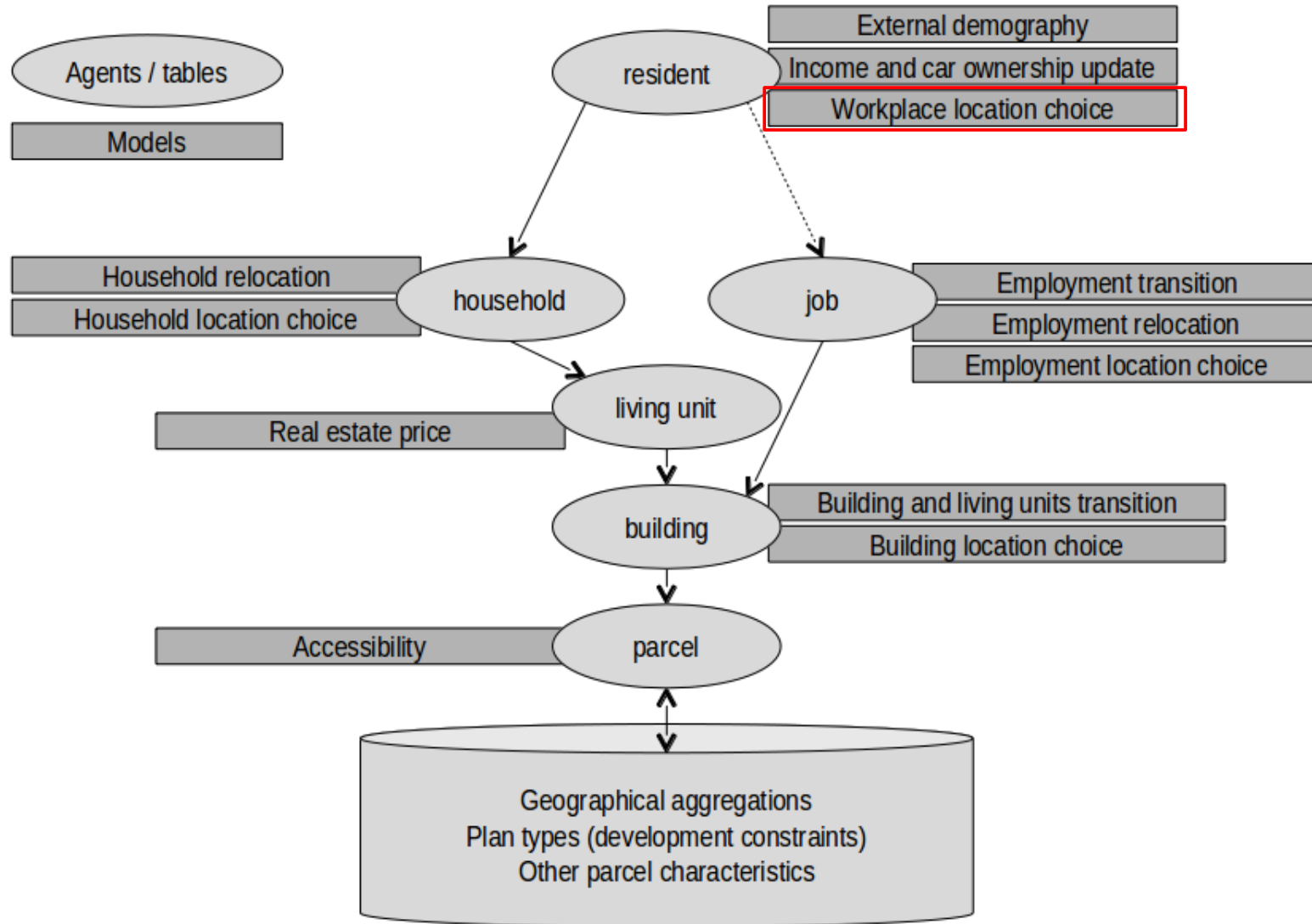Type 4 = Retail Trade (NOGA code G47)

Type 5 = Hotel & Gastronomy (NOGA code I)
Type 6 = Transport & Communication (NOGA code J)
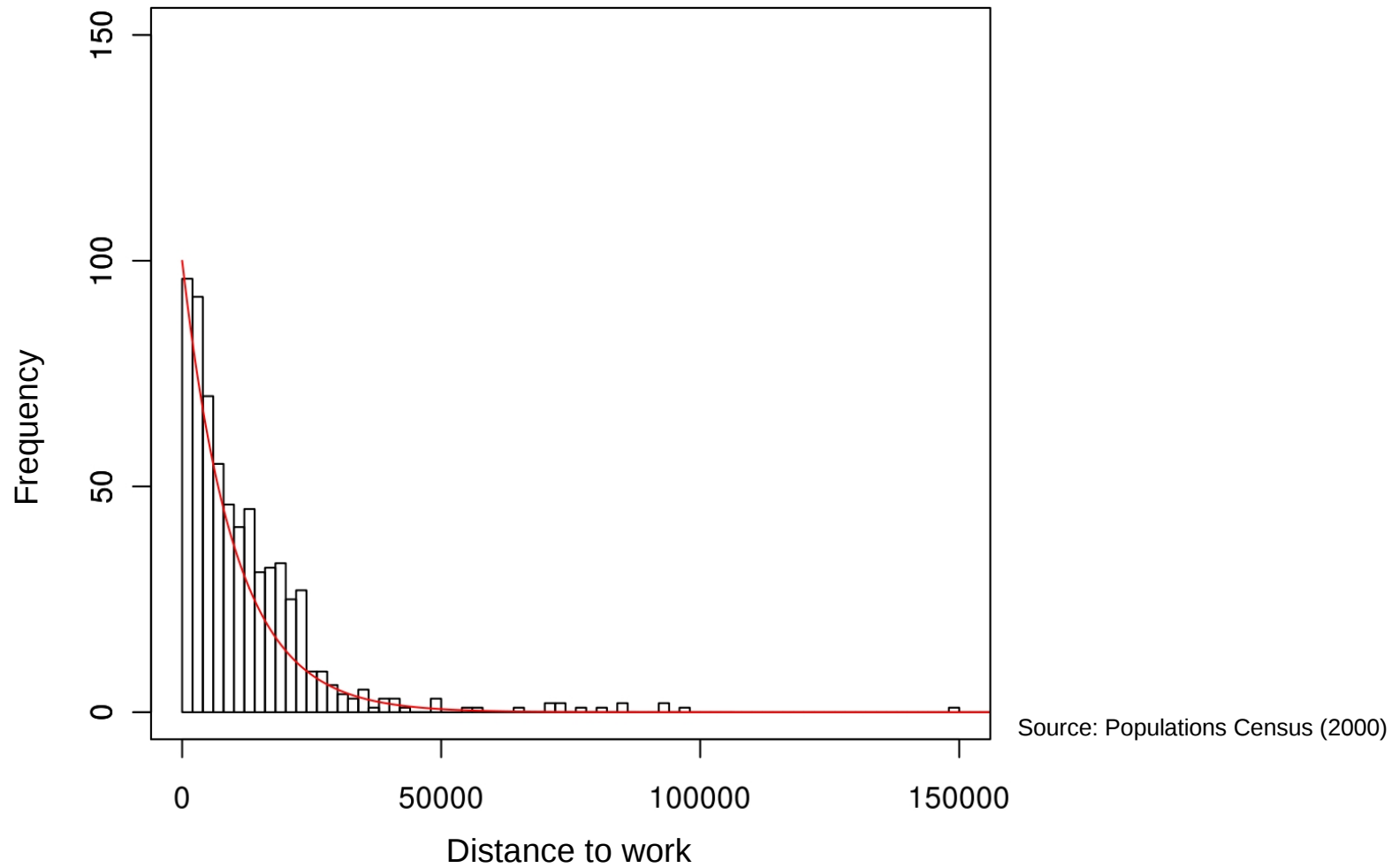Type 7 = Service & Finance (NOGA code K - N)
Type 8 = Health (NOGA code Q)

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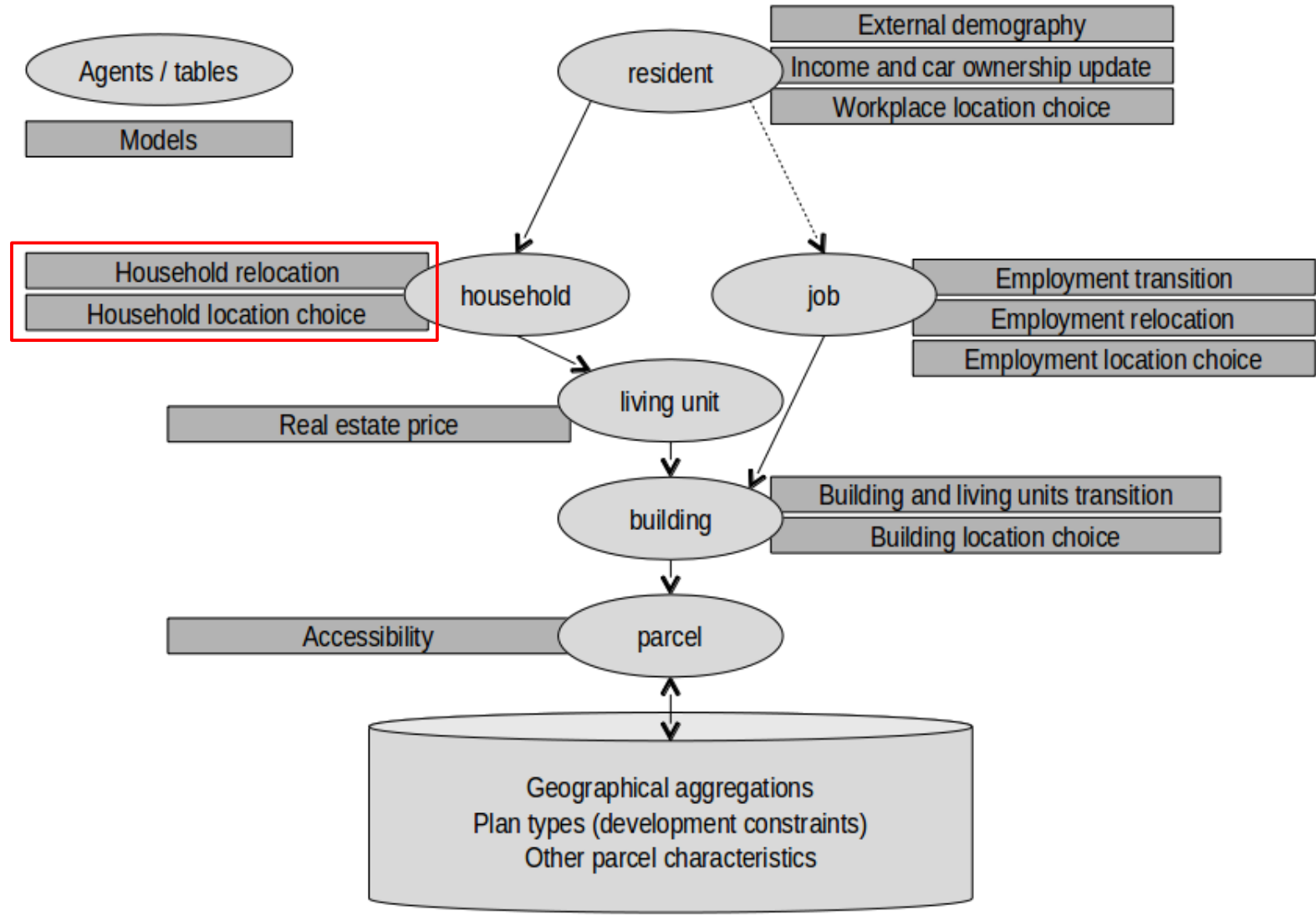European Research Area
Funded under Socio-economic Sciences & Humanities

Models – Workplace location choice

Models – Workplace location choice

Source: Populations Census (2000)

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Models – Households

Models – Household transition and relocation

Relocation probability

Probability to move

- 0.35
- 0.3
- 0.25
- 0.2
- 0.15
- 0.1
- 0.05
- 0

Age of head: <30, 30-44, 45-64, >64
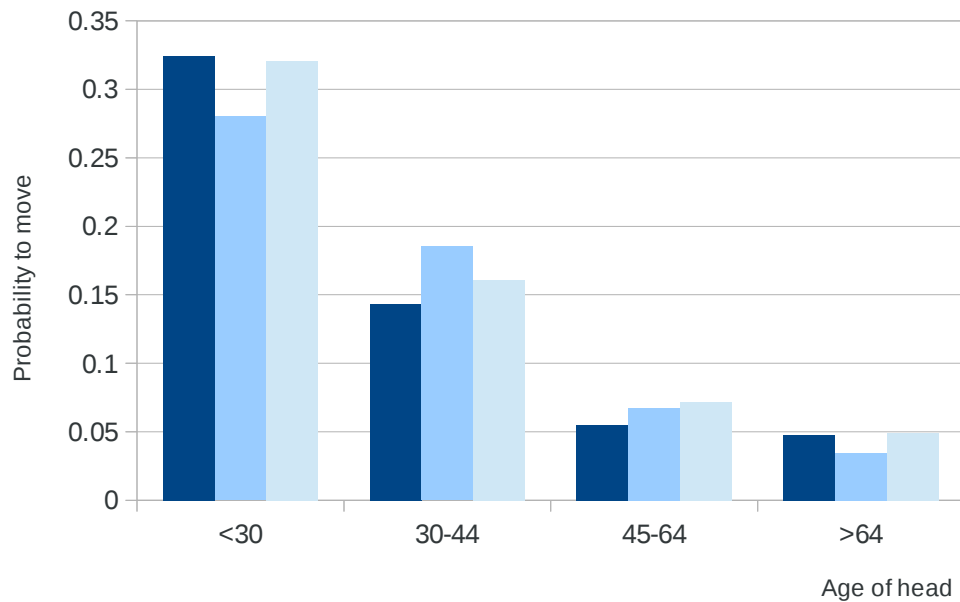
Income
- ■ <48000
- ■ 48000-96000
- ■ >96000

Source: Beige (2005)

Reason to move

- Other reason
- Change in relationship status
- Buying residential property
- Quality of residence/environment
- Job
- Family
- No reason given

Number of households: 0, 50, 100, 150, 200, 250, 300
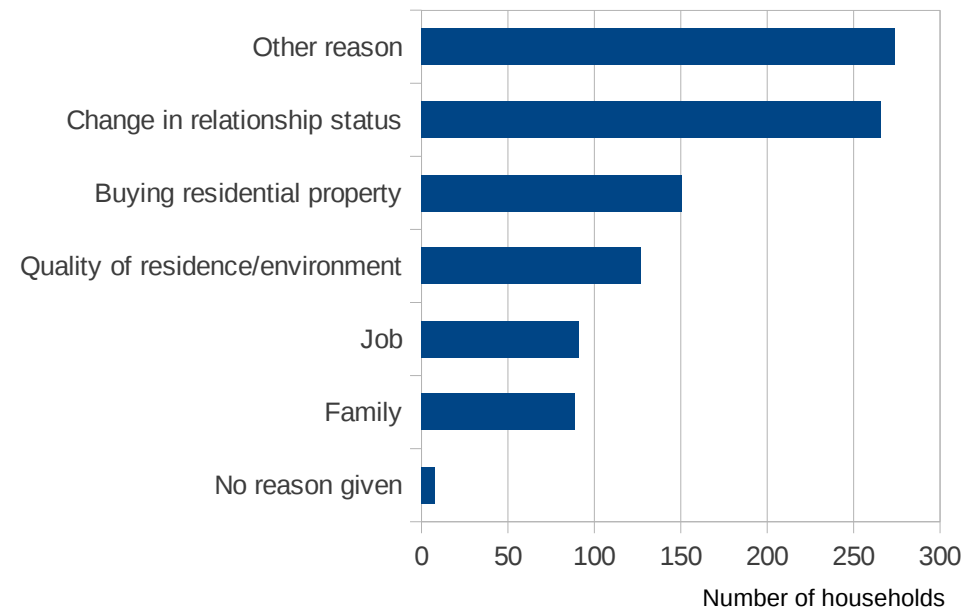
Survey: Belart (2010)

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Models – Household location choice
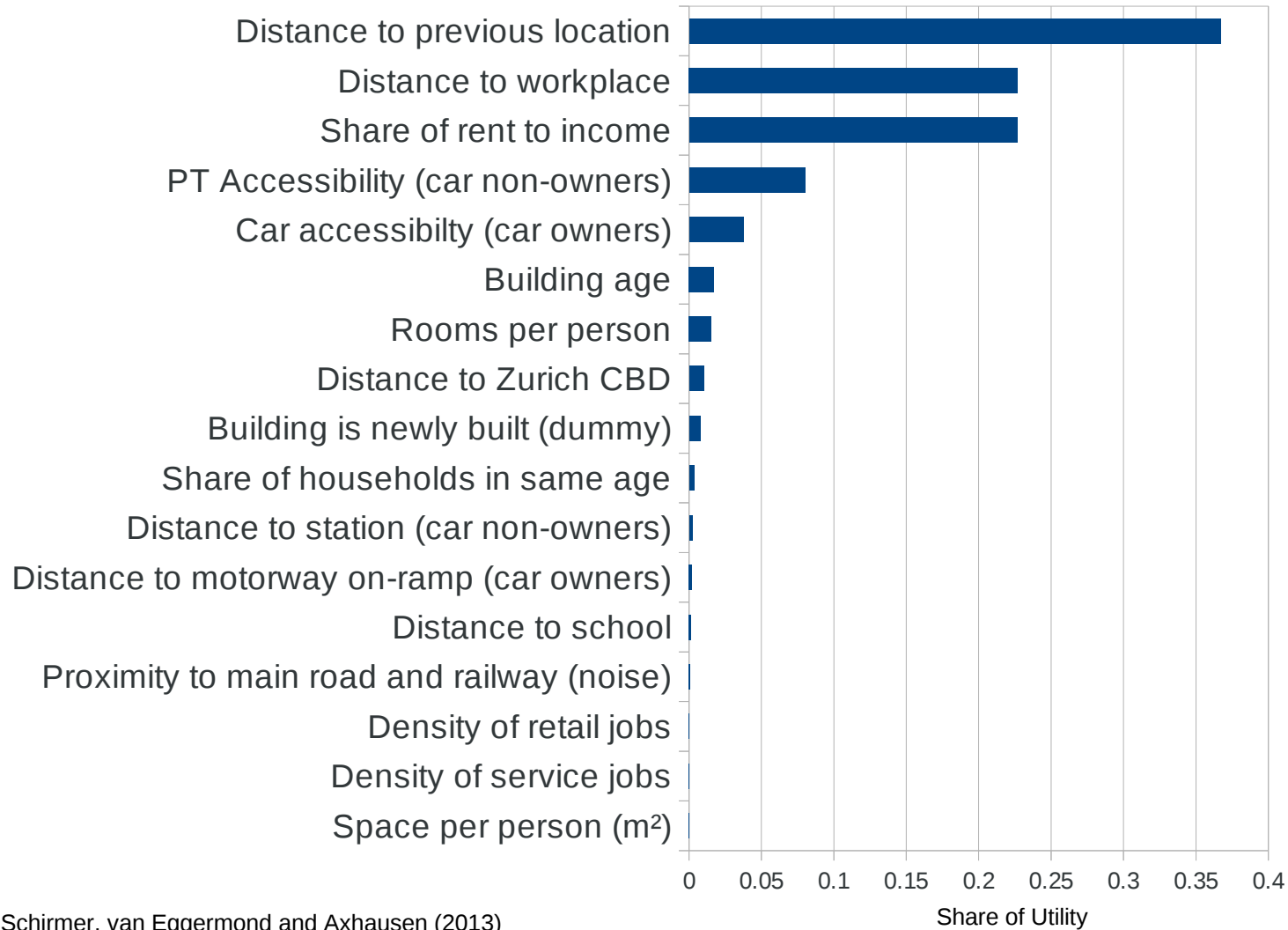
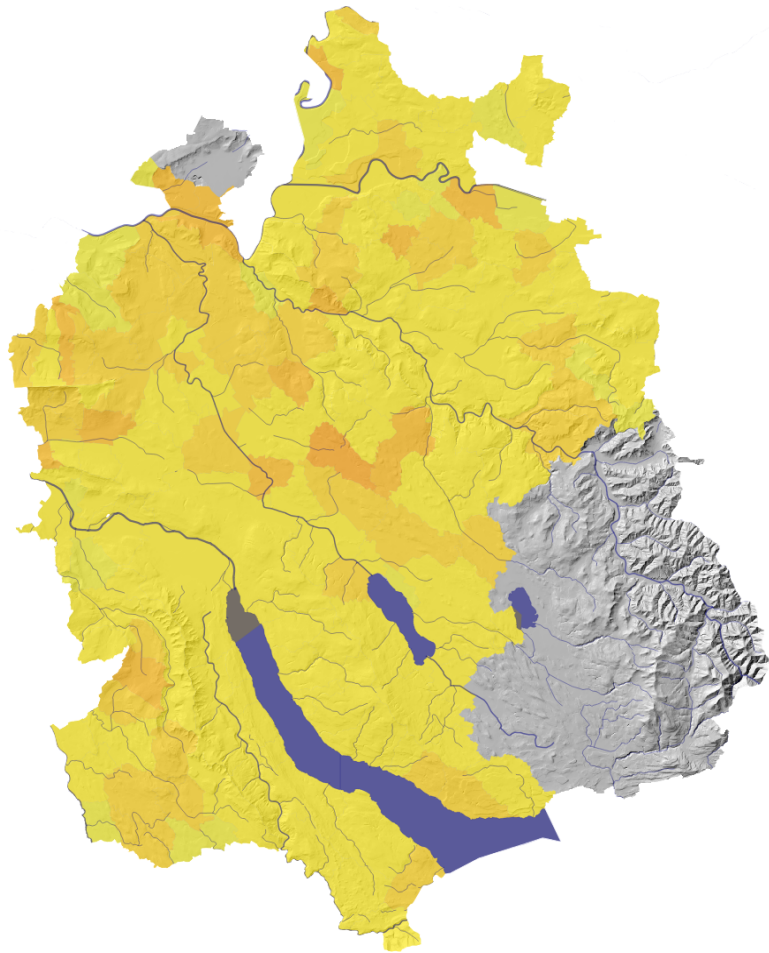Source: Schirmer, van Eggermond and Axhausen (2013)
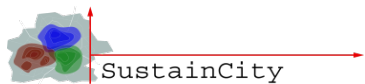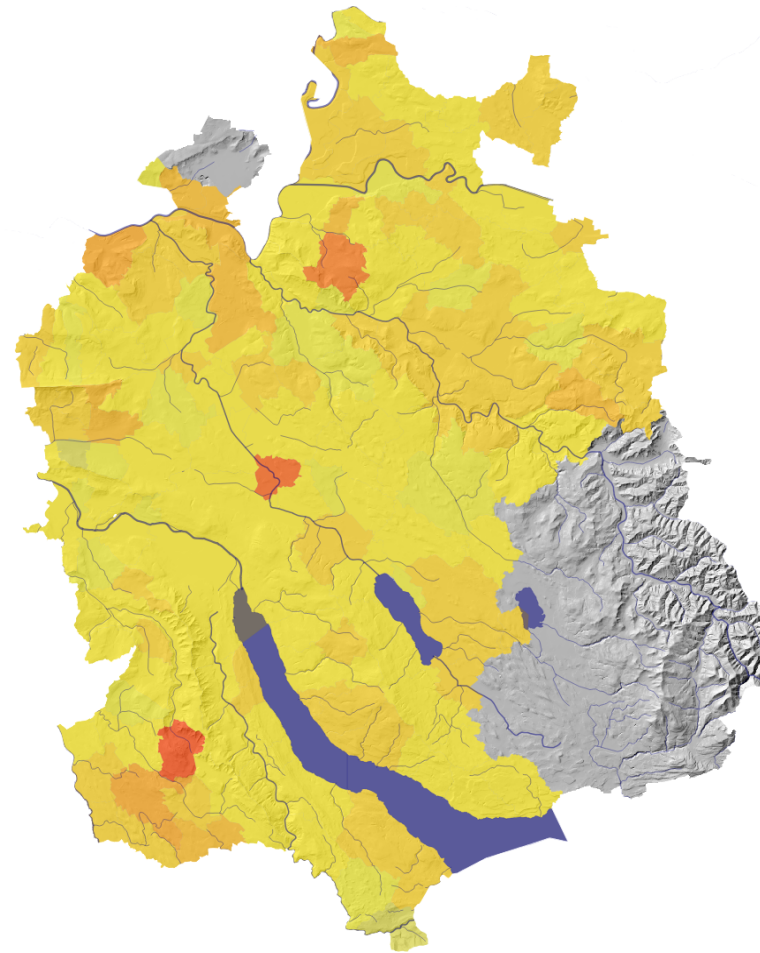
Overview

Context

Data processing
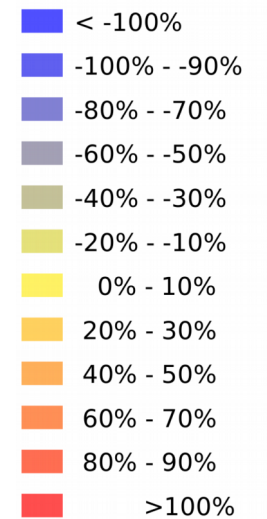
Modelling

Simulation

Findings

Simulation – Persons

Observed development 2001 - 2008:
Persons per km² of municipality

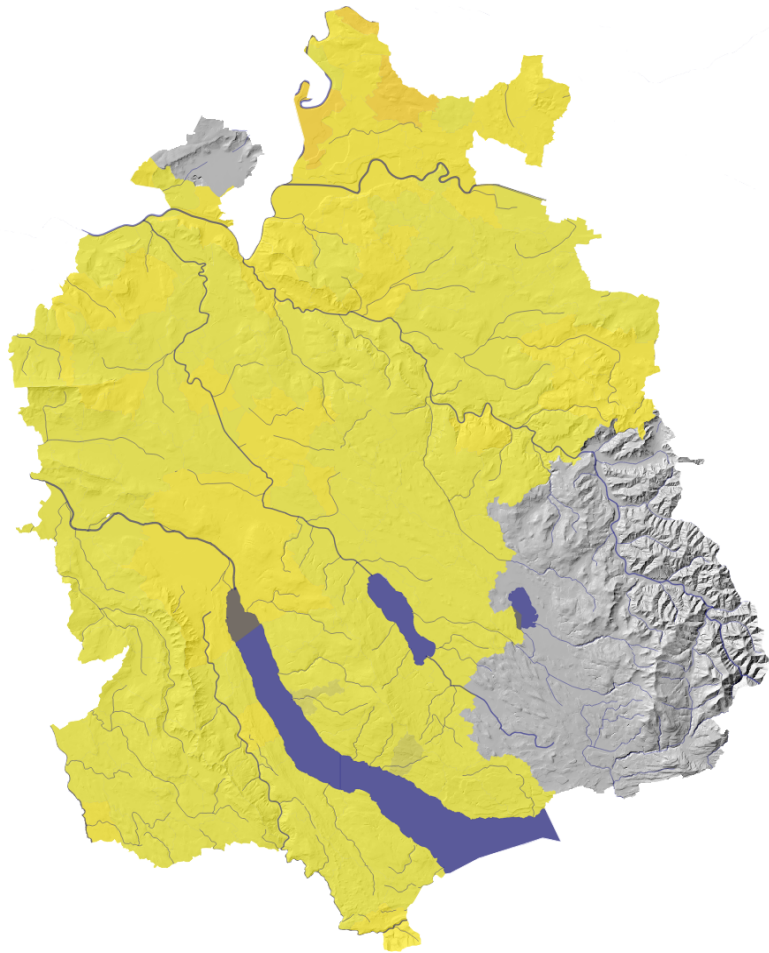Simulated development 2001 - 2008:
Persons per km² of municipality

Legend

- ⬛ < -100%
- ⬛ -100% - -90%
- ⬛ -80% - -70%
- ⬛ -60% - -50%
- ⬛ -40% - -30%
- ⬛ -20% - -10%
- ⬛ 0% - 10%
- ⬛ 20% - 30%
- ⬛ 40% - 50%
- ⬛ 60% - 70%
- ⬛ 80% - 90%
- ⬛ >100%

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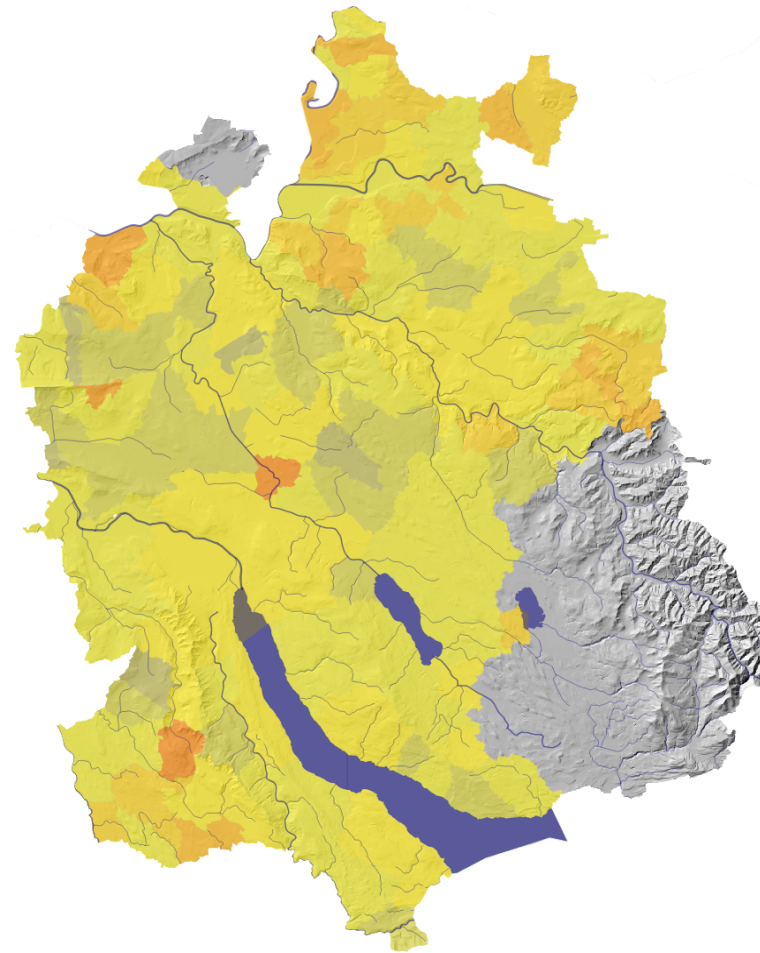
Funded under Socio-economic Sciences & Humanities

Simulation – Persons

Difference of simulation to validation 2001:
Persons per km² of municipality

Difference of simulation to validation 2008:
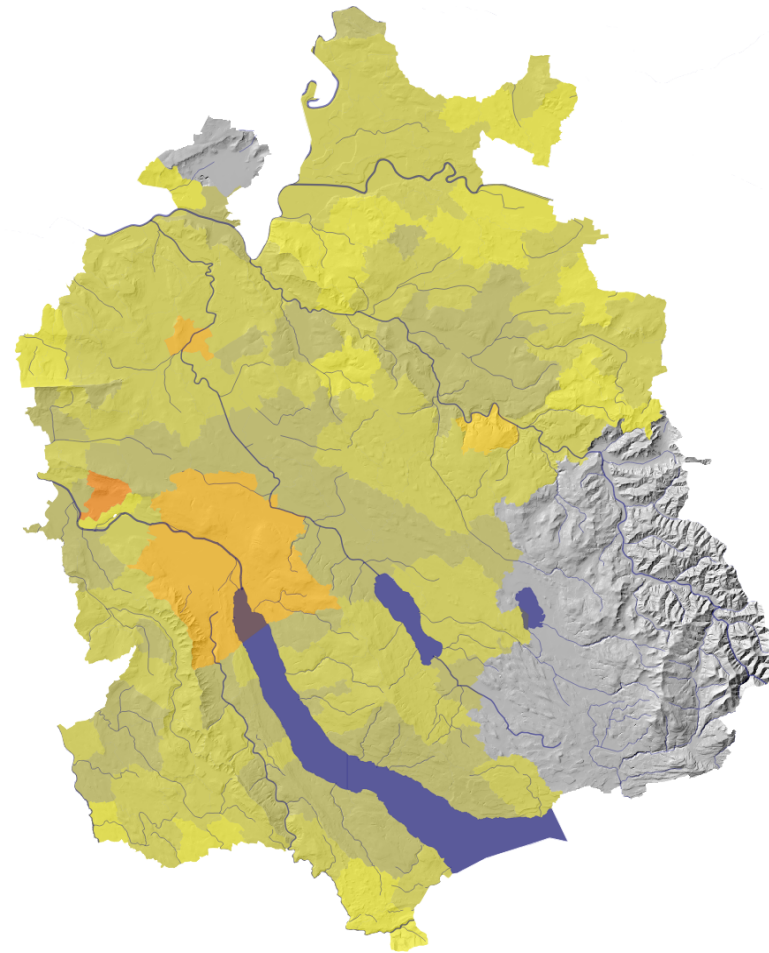Persons per km² of municipality

Legend

■	< -100%
■	-100% - -90%
■	-80% - -70%
■	-60% - -50%
■	-40% - -30%
■	-20% - -10%
■	0% - 10%
■	20% - 30%
■	40% - 50%
■	60% - 70%
■	80% - 90%
■	>100%

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Simulation – Jobs

Observed development 2001 - 2008:
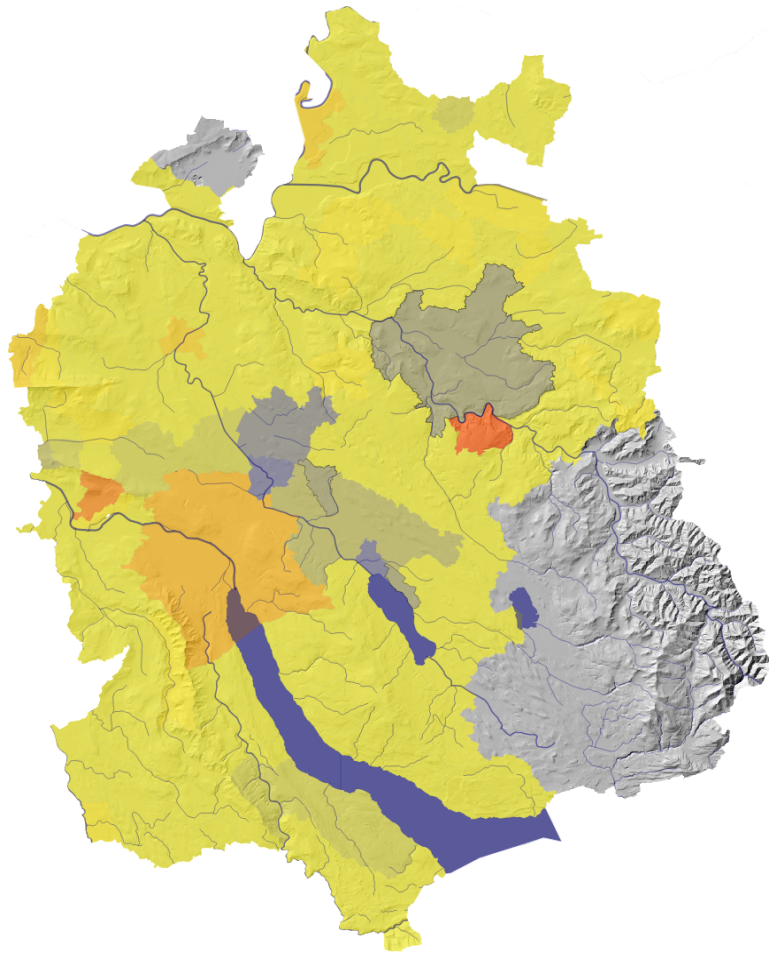Jobs per km² of municipality

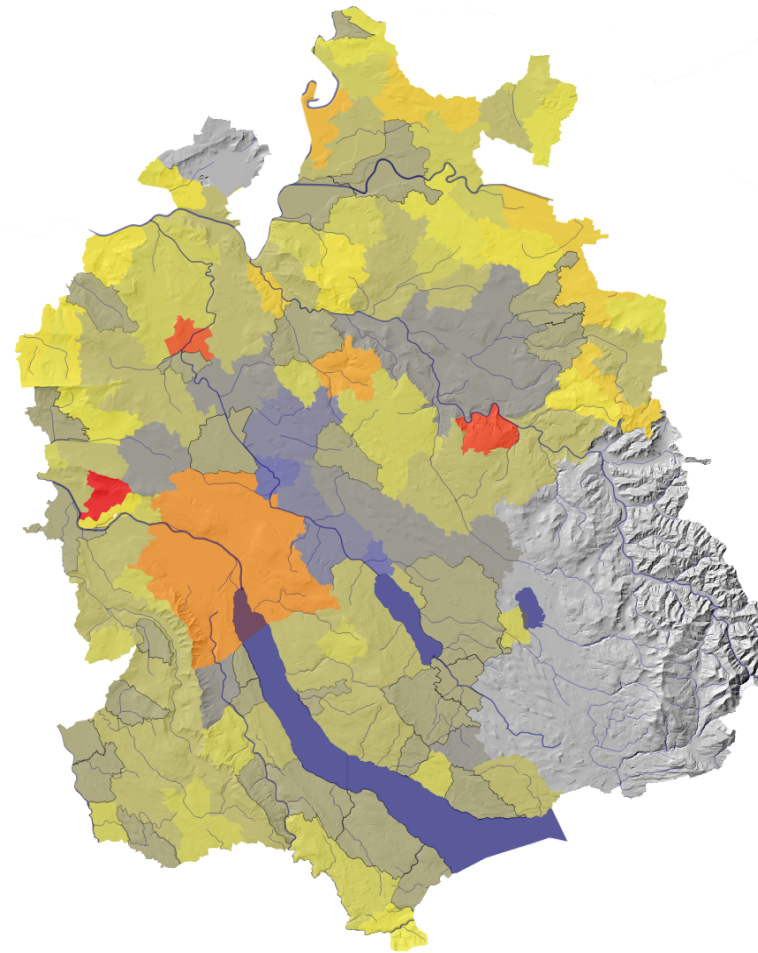Simulated development 2001 - 2008:
Jobs per km² of municipality

Legend

- ■ < -100%
- ■ -100% - -90%
- ■ -80% - -70%
- ■ -60% - -50%
- ■ -40% - -30%
- ■ -20% - -10%
- ■ 0% - 10%
- ■ 20% - 30%
- ■ 40% - 50%
- ■ 60% - 70%
- ■ 80% - 90%
- ■ >100%

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Simulation – Jobs

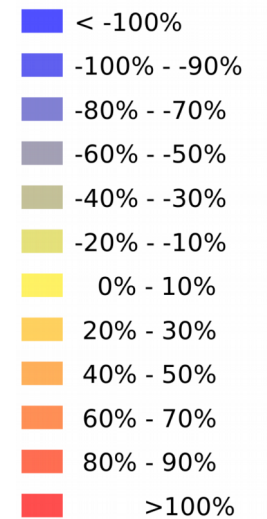

Difference of simulation to validation 2001:
Jobs per km² of municipality

Difference of simulation to validation 2008:
Jobs per km² of municipality

Legend

Color	Range
	< -100%
	-100% - -90%
	-80% - -70%
	-60% - -50%
	-40% - -30%
	-20% - -10%
	0% - 10%
	20% - 30%
	40% - 50%
	60% - 70%
	80% - 90%
	>100%

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Scenario: Road pricing

Topic

Cordon for city of Zurich

Additional cost of 5 Euros for all red links

The toll is imposed from 06:00 – 24:00

Implementation

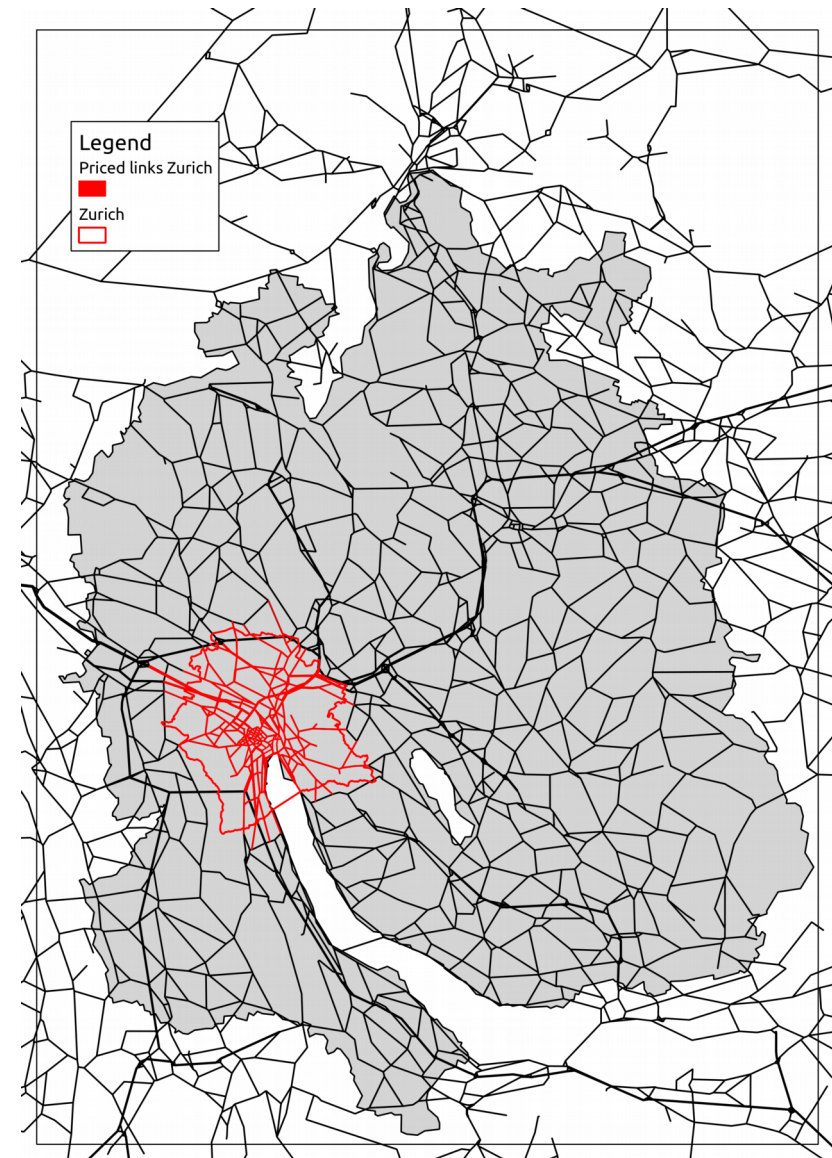Adaptation of MATSim configuration

Expected Effects

Suppressed trips

More public transport

Less congestion

Accessibility decrease in Zurich city

Legend
Priced links Zurich

Zurich

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Scenario: Densification

Topic

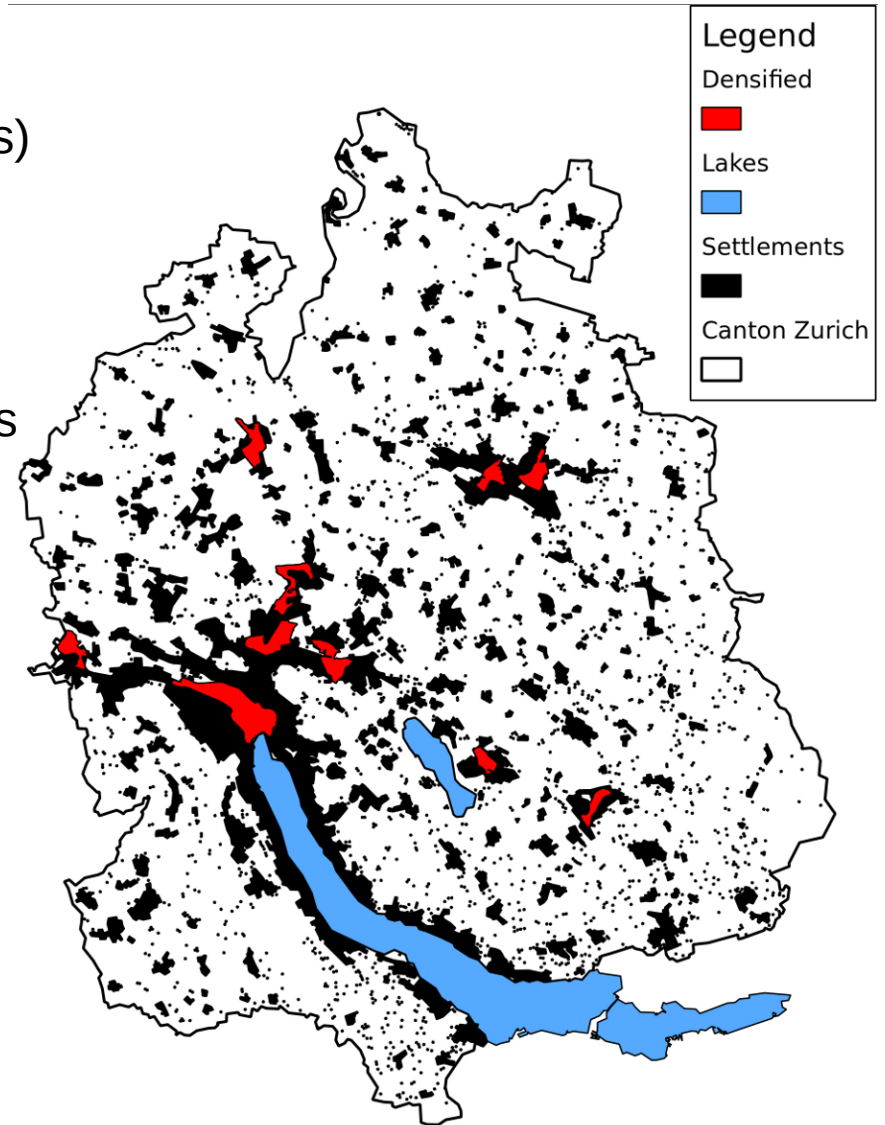Cantonal directive plan (11 densification areas)

Densification of centers

Implementation

Increase FAR of parcels in densification zones

Expected effects

Increased building activity

Less vehicle miles travelled

Legend
Densified

Lakes

Settlements

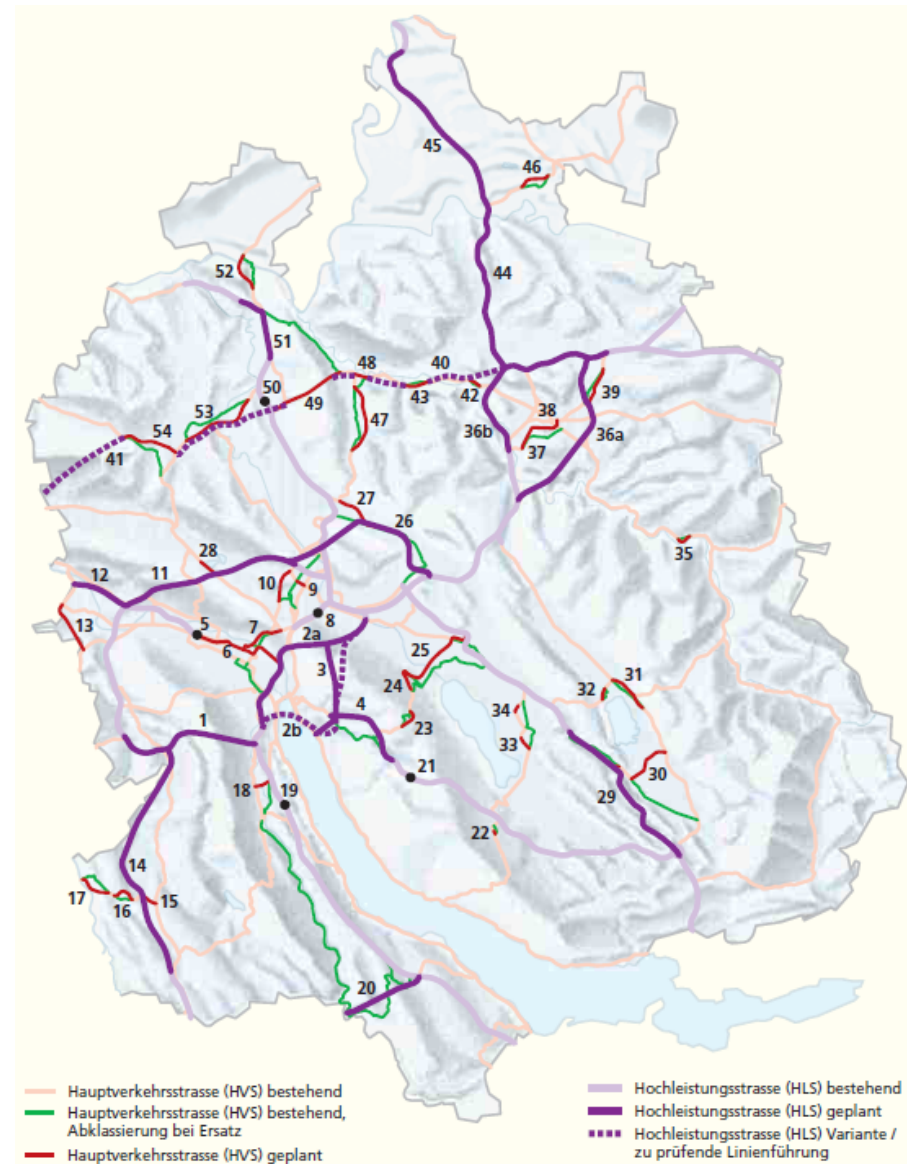Canton Zurich

Scenario: New infrastructure

Topic

New infrastructure facilities from
cantonal directive plan

Implementation

Adaptation of MATSim network

Expected effects

Locally increased accessibility

According local growth

Source: Canton Zurich (2007), Cantonal Directive Plan

Overview

Context

Data processing

Modelling

Simulation

Findings

Source background image: GoogleEarth

Findings

Methodological

Reproducible research possible with big data

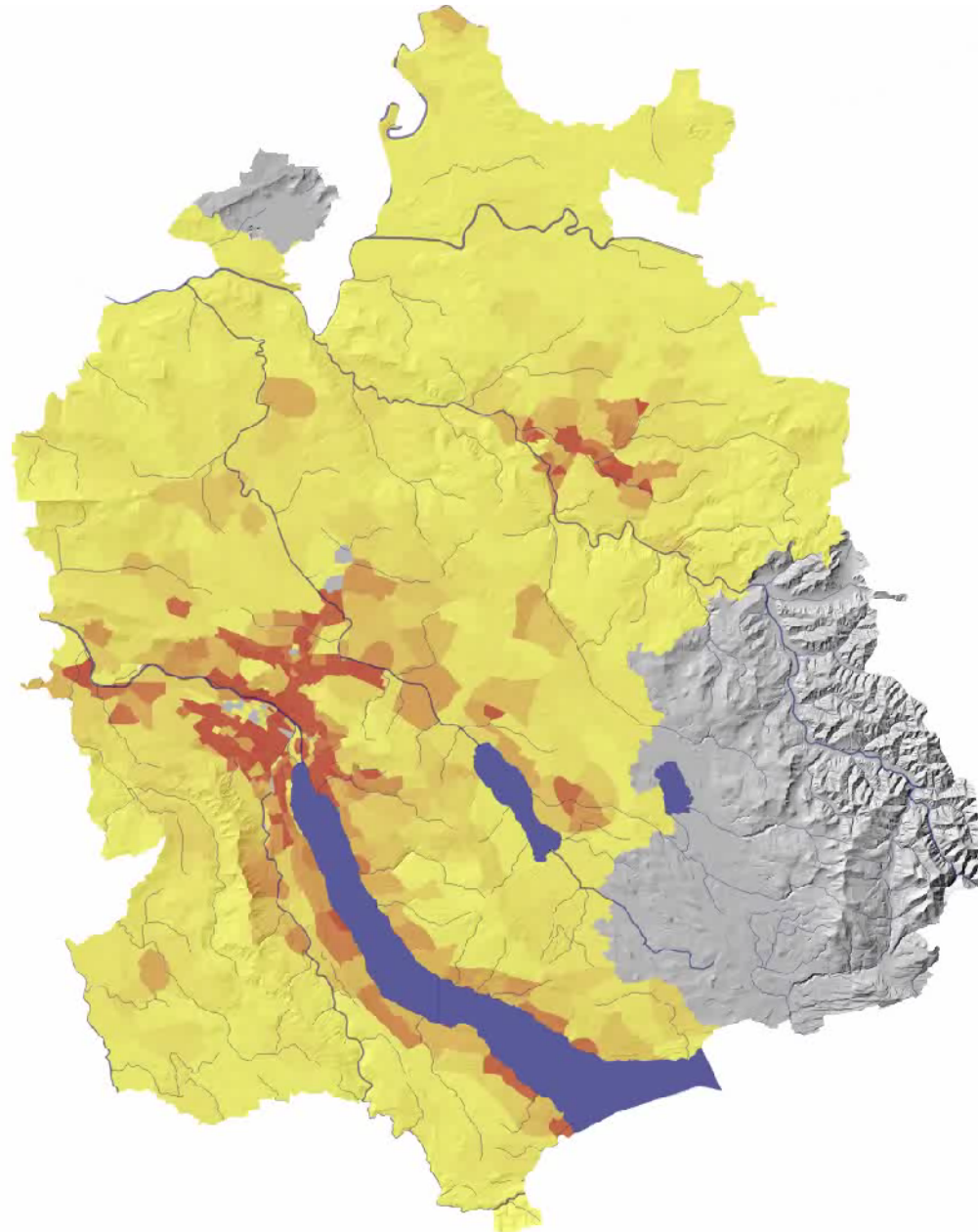Harmonised data warehouses with individual data needed

Models can be estimated on UrbanSim base year

Models can be improved with surveys (recently moved households)

Simulation of households fits to observation

Simulation of employment reflects limited data quality

Isolation of scenario effects is challenging

SustainCity

2000

2010

2020

2030

SustainCity Conference on
Integrated Land-Use and Transport Simulation, 18.04.2013

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European Research Area

Funded under Socio-economic Sciences & Humanities