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Rethinking the roles of family, market & state

The dynamic micro-simulation platform MicroWELT for the comparative study of the impact of socio-demographic change on the sustainability and transfer flows in welfare states.

Microdata in Macromodels Workshop

Martin Spielauer – WIFO – April 2025

UK Research and Innovation

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microWELT (Welfare Transfer)

- Dynamic micro-simulation model for the comparative study of the impact of socio-demographic change on the sustainability and transfer flows in welfare states.
- Open modeling platform used – and extended - in various projects

The Grande Vision: Combining

- a longitudinal representation of society in its diversity, with
- a depiction of the operations of the welfare state (tax and benefit systems, institutional settings) and
- individual accounting of income flows, consumption, and welfare transfers (public and private), to
- assess the sustainability and adjustment needs of the welfare state, and its
- adequacy and distributive operations from a longitudinal perspective

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Guy Orcutt (1957) A new type of socio-economic system

- Improves the “limited predictive usefulness” of economic models concerning effects of governmental action
- Includes distributions in predictions
- Makes full use of knowledge about decision-making units
- Is not bound by restrictive assumptions of “absurdly simple relationships about elemental decision-making units” in order to be able to aggregate.
- Is “.. intelligible to people of only modest mathematical sophistication”

1956 IBM introduced the 305 RAMAC – 1st computer with disk drive.

Stack of 50 24" discs: 4.4MB total

Annual lease: $35,000

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DMS versus ABM

	DMS	ABM
Modelling focus	Individuals as statistical units	Autonomous decision-makers (agents)
Behavioural modelling	Data/regression-driven, rule based	Theory-driven. Rich, adaptive, and interactive behaviors
Interactions	Flexible but typically limited	Core feature – agents interact with each other & environment
Use case	Policy analysis, tax/benefit systems, demographic projections	Complex systems, social behavior, market dynamics

- …"Both approaches have evolved in almost total ignorance of each other and a synthesis might be valuable" (Troitzsch 1997, Social Science Microsimulation)

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Rationale

- Population heterogeneity matters
  - No representative agent
  - Focus on distribution
- Behaviours or systems more stable / better understood / defined on micro level
  - Composition effects
  - Taxes and transfers defined at micro level
- Individual biographies matter; e.g., pension contribution histories
- Communication and transfers between individuals matters

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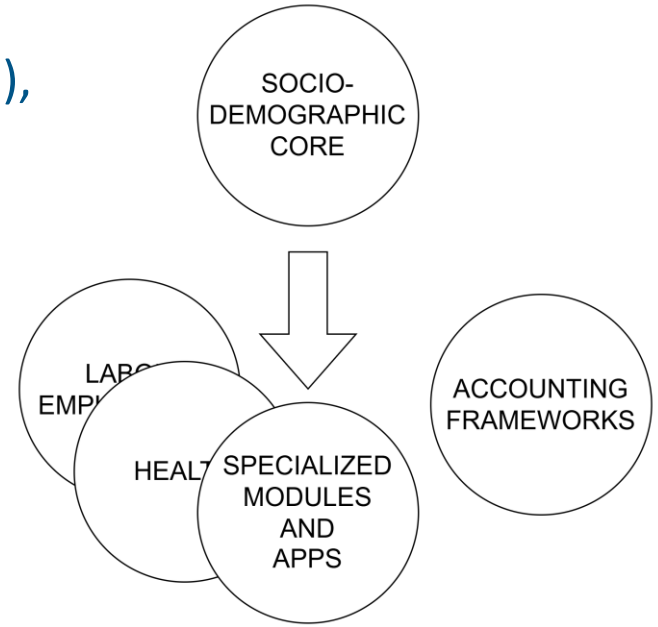
Examples

- Demographic projections: Famsim (EU), RiskPaths (EU, CAN), Demosim (CAN), STATSIM (AT)
- Specialized applications building on/extending demographic projections
  - Education: Famsim++ (AT), microCC (US)
  - Health: Pohem (CAN), Dynamis-Pop (MRT, NPL)

  .. Labor & Employment, Long-Term Care, Tax-Transfer Systems

  - Pensions: DypES (ES), DypenSI (SI), microNPS (IND)
- Comprehensive / Multi-Purpose models
  - National: LifePaths (CAN), microDEMS (AT)
  - Comparative: microWELT (EU, US)



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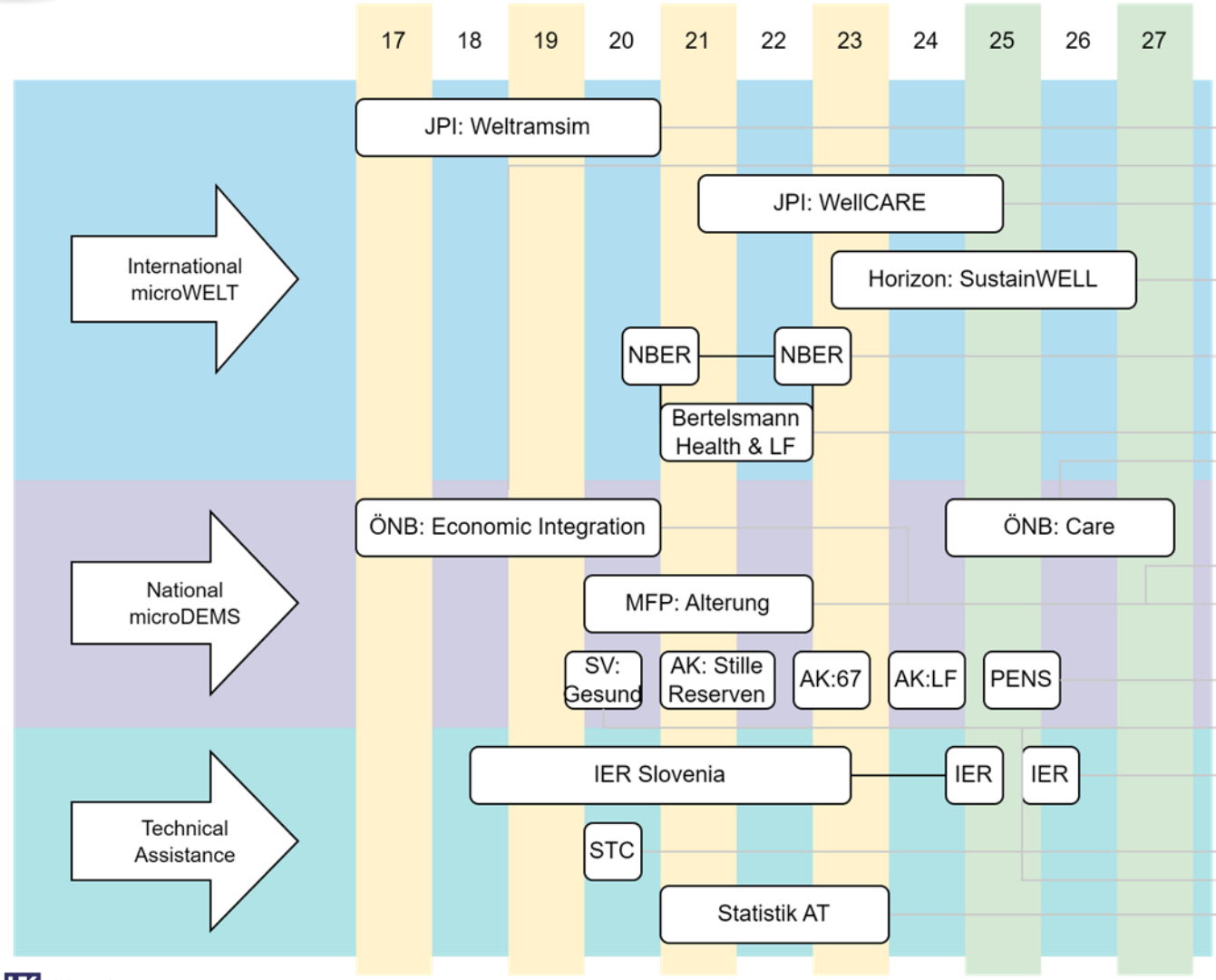
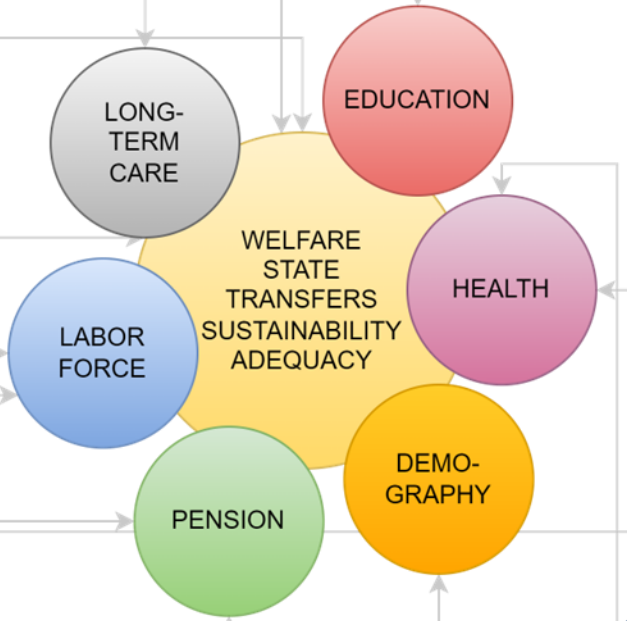
DMS at WIFO





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Characteristics

- Continuous time
- Time-based (Interacting population)
- Long-term projections: “what-if” scenario support and alignment options
- Implemented in Modgen/openM++

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Typical statistical approach

- Piece-wise constant hazard regression for generating random waiting times to events
  - Proportional model: Hazard = baselines hazards * relative risks
  - Convenient: waiting times exponentially distributes within time piece
  - Relative risks often very persistent
- Scenarios
  - General trends (in baseline)
  - Specific trends (e.g., closing gaps)
  - Alignment: Keeping relative risk structure, calibrating baseline for given aggregate outcome

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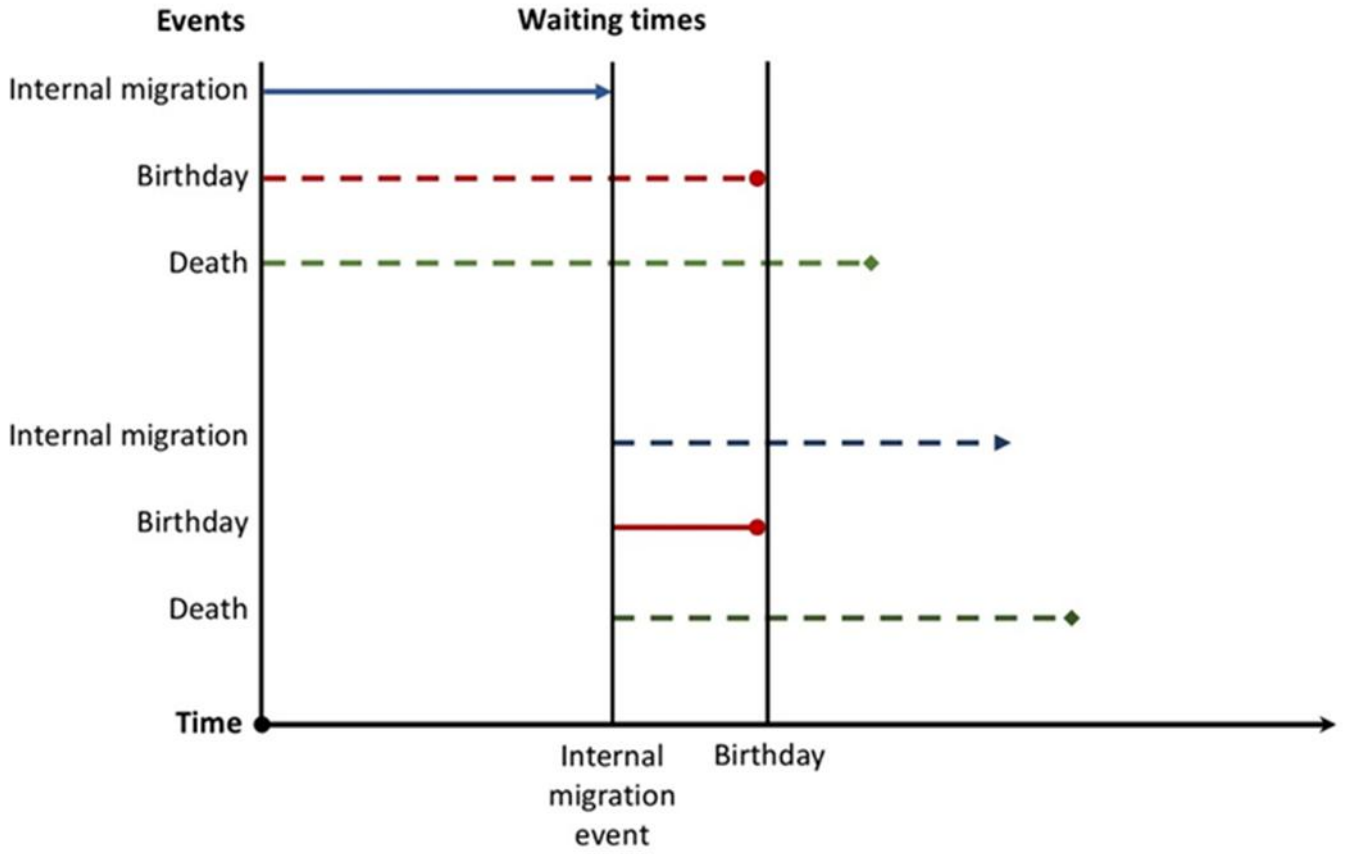
Evolvement of time

- Time driven by events
- Stochastic events and clock events

- At each step, all affected waiting times are updated
- Interacting populations: whatever event experienced by an actor moves time for all others



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Technology: Modgen / openM++

- Freely available (Modgen - Statistics Canada) / Open-Source (openM++)
  - Transition to openM++ also by Statistics Canada
- Based on C++; Code is pre-compiled to C++
  - Combines generic language with specific functionality
  - Modgen: Microsoft Visual Studio IDE (Windows) / openM++ platform independent
  - Rich set of functions and mechanisms for implementing microsimulations
  - Developer can focus on model-specific code; Common mechanisms such as event queues & handling are readily provided and hidden.
  - Provides components like GUI, automatically generated documentation
  - Rich tabling language for longitudinal output
  - Very efficient for handling continuous time and interacting population models

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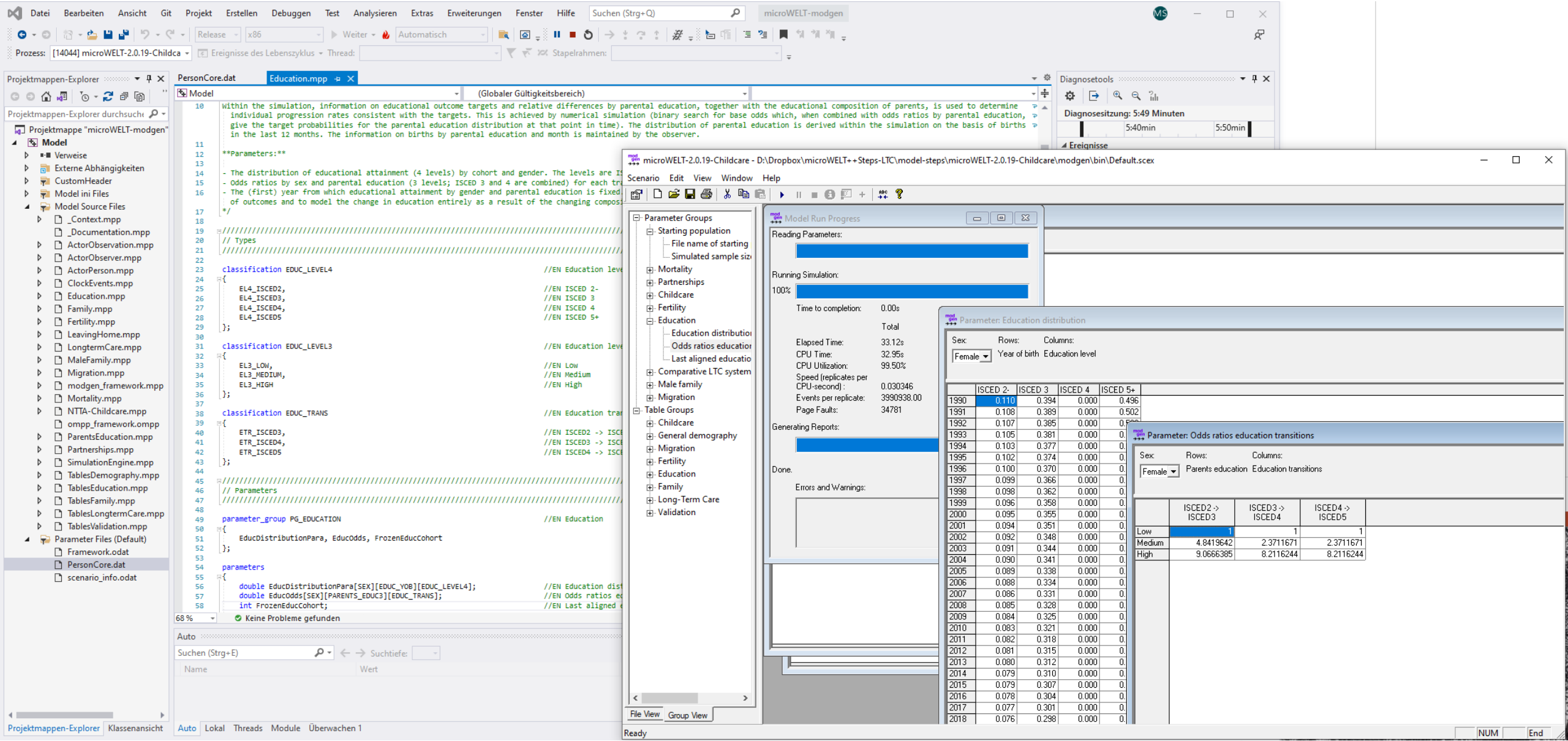
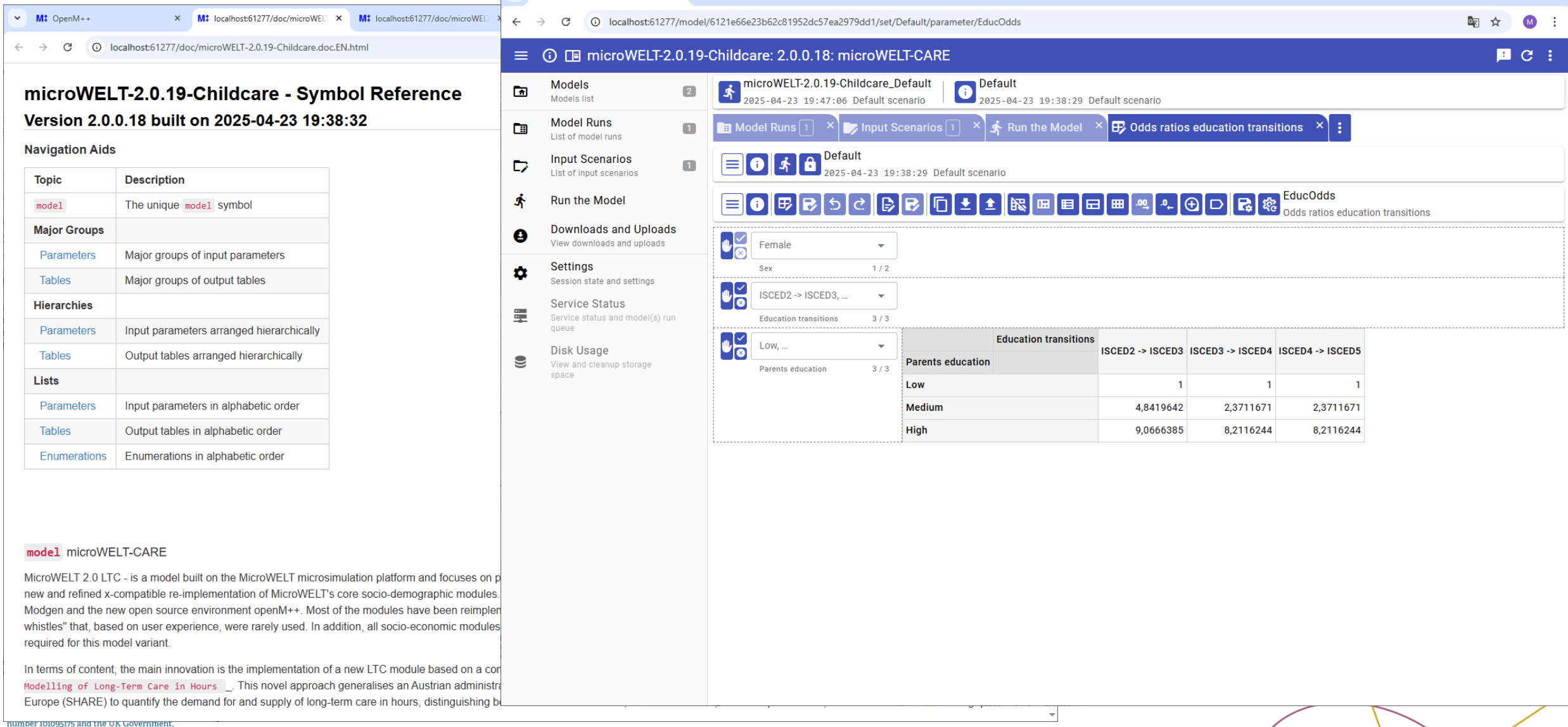
Modgen GUI


Projektmappen-Explorer
PersonCore.dat
Education.mpp
Diagnosetools
microWELT-2.0.19-Childcare - D:\Dropbox\microWELT++Steps-LTC\model-steps\microWELT-2.0.19-Childcare\modgen\bin\Default.scex
Scenario Edit View Window Help
Parameter Groups
Starting population
Mortality
Partnerships
Childcare
Fertility
Education
Comparative LTC system
Male family
Migration
Table Groups
General demography
Long-Term Care
Validation
Model Run Progress
Reading Parameters:
Running Simulation:
Time to completion:
Elapsed Time:
CPU Time:
CPU Utilization:
Generating Reports:
Done.
Errors and Warnings:
Parameter: Education distribution
Parameter: Odds ratios education transitions
Ready

openM++ GUI


OpenM++
localhost:61277/doc/microWELT-2.0.19-Childcare.doc.EN.html
microWELT-2.0.19-Childcare - Symbol Reference
Version 2.0.0.18 built on 2025-04-23 19:38:32
Navigation Aids
Topic
Description
model
The unique model symbol
Major Groups
Parameters
Major groups of input parameters
Tables
Major groups of output tables
Hierarchies
Parameters
Input parameters arranged hierarchically
Tables
Output tables arranged hierarchically
Lists
Parameters
Input parameters in alphabetic order
Tables
Output tables in alphabetic order
Enumerations
Enumerations in alphabetic order
model microWELT-CARE
MicroWELT 2.0 LTC - is a model built on the MicroWELT microsimulation platform and focuses on p
new and refined x-compatible re-implementation of MicroWELT's core socio-demographic modules.
Modgen and the new open source environment openM++. Most of the modules have been reimplen
whistles" that, based on user experience, were rarely used. In addition, all socio-economic modules
required for this model variant.
In terms of content, the main innovation is the implementation of a new LTC module based on a cor
Modelling of Long-Term Care in Hours
. This novel approach generalises an Austrian administra
Europe (SHARE) to quantify the demand for and supply of long-term care in hours, distinguishing b
number 101095175 and the UK Government.
OpenM++
localhost:61277/model/6121e66e23b62c81952dc57ea2979dd1/set/Default/parameter/EducOdds
microWELT-2.0.19-Childcare: 2.0.0.18: microWELT-CARE
Models
Models list
Model Runs
List of model runs
Input Scenarios
List of input scenarios
Run the Model
Downloads and Uploads
View downloads and uploads
Settings
Session state and settings
Service Status
Service status and model(s) run queue
Disk Usage
View and cleanup storage space
microWELT-2.0.19-Childcare_Default
2025-04-23 19:47:06 Default scenario
Default
2025-04-23 19:38:29 Default scenario
Model Runs 1
Input Scenarios 1
Run the Model
Odds ratios education transitions
Default
2025-04-23 19:38:29 Default scenario
EducOdds
Odds ratios education transitions
Female
Sex 1 / 2
ISCED2 -> ISCED3, ...
Education transitions 3 / 3
Low, ...
Parents education 3 / 3
Education transitions
Parents education
ISCED2 -> ISCED3
ISCED3 -> ISCED4
ISCED4 -> ISCED5
Low 1 1 1
Medium 4,8419642 2,3711671 2,3711671
High 9,0666385 8,2116244 8,2116244

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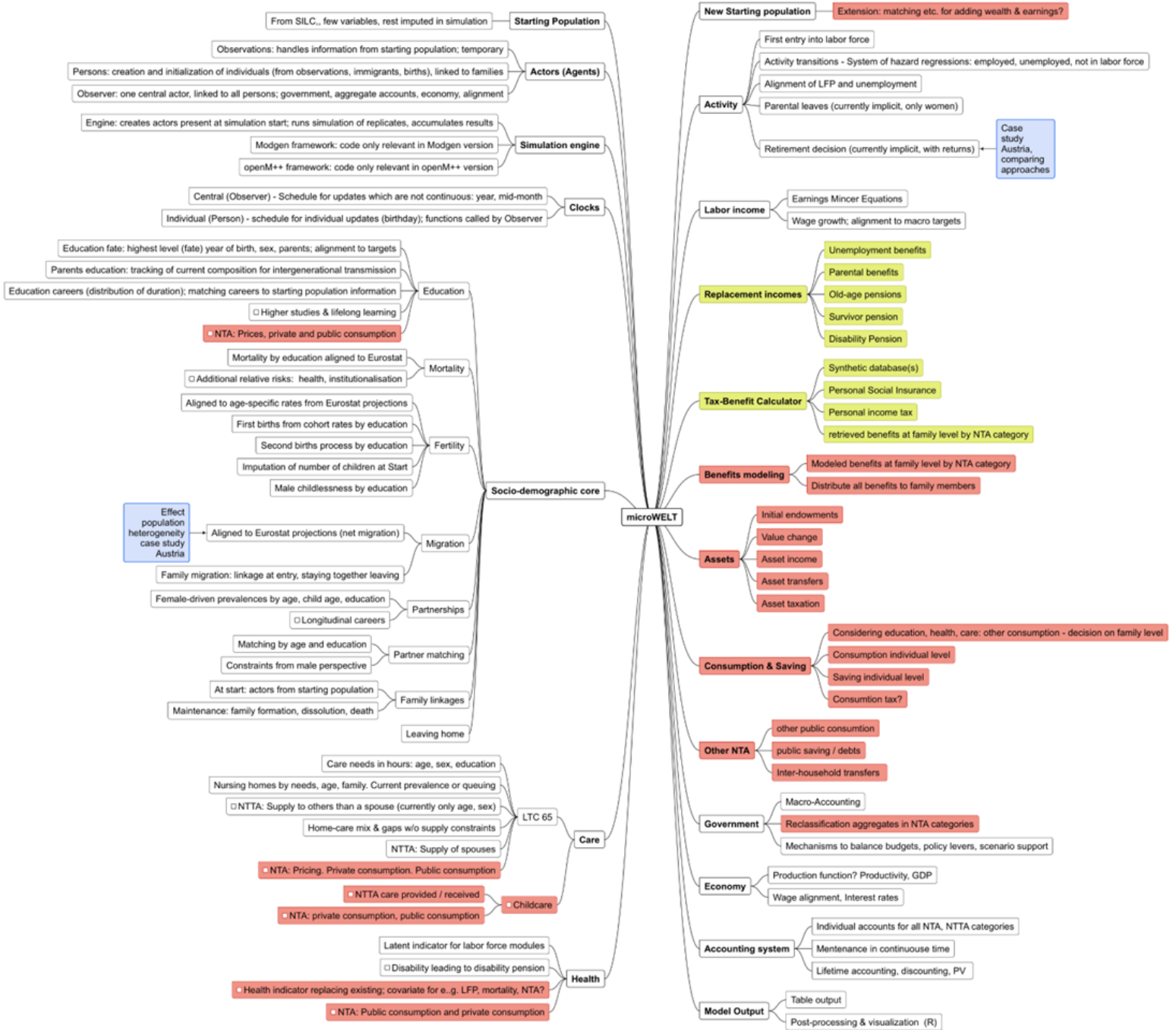
microWELT Components

- Main Actors: Persons, Observer
- Socio-Demographic Core: Fertility, Mortality, Family, Migration, Education
- Health and Care
- Economic activity
- Earnings
- Taxes & Transfers
- Consumption & Saving
- Assets
- Macro Economy & Government



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Population projections: General approach:

- Ability to re-produce official population projections …
- … accounting for relative differences in mortality and fertility by education

Education

- Highest level (of 4): scenario-based a/o intergenerational transmission
- School enrollment by level

Health limitations: by gender, age, education; mechanisms for modeling trends

Nuclear families

- Partnerships female-driven, dependent on age, education, children, age of youngest child
- Partner matching reproduce observed patterns of age and education distributions

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Cross-sectional imputation models

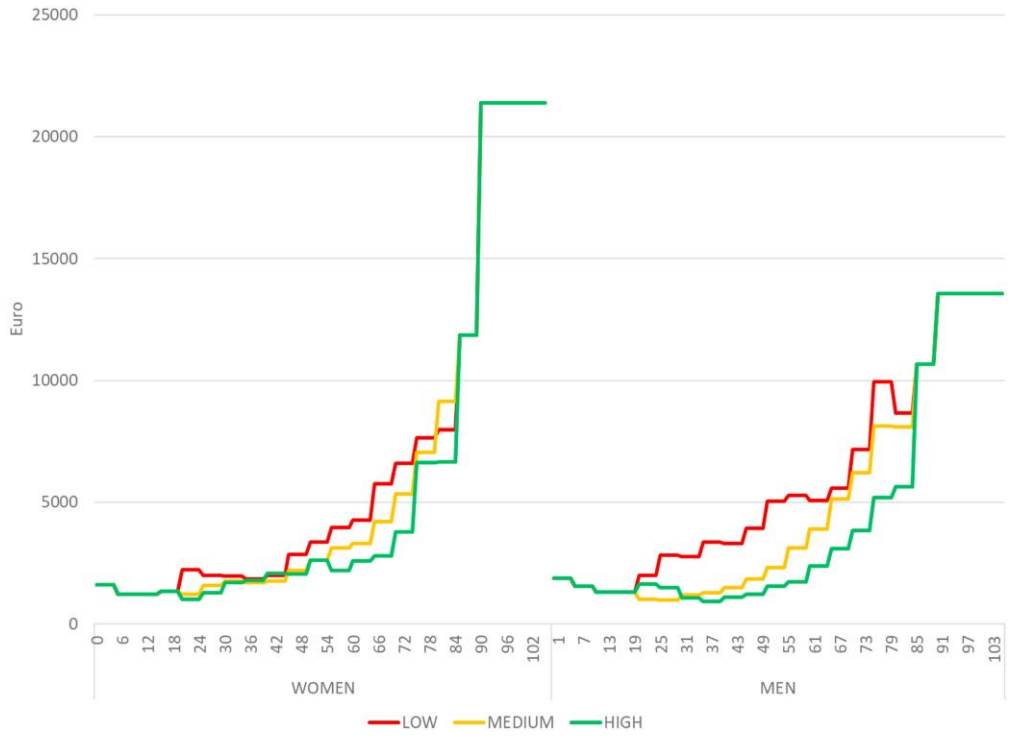
Cross-sectional imputation models typically depart from existing projection models built on population projections; added detail:

- Composition effects
- Differential life expectancy

Applications

- Health costs by education
- Labor force projections
- Long-Term Care

Example: health costs



Horvath T., T. Leoni, P. Reschenhofer, M. Spielauer (2023) Socio-economic Inequality and Healthcare Costs Over the Life Course – A Dynamic Microsimulation Approach - Public Health, (219), pp.124-130,

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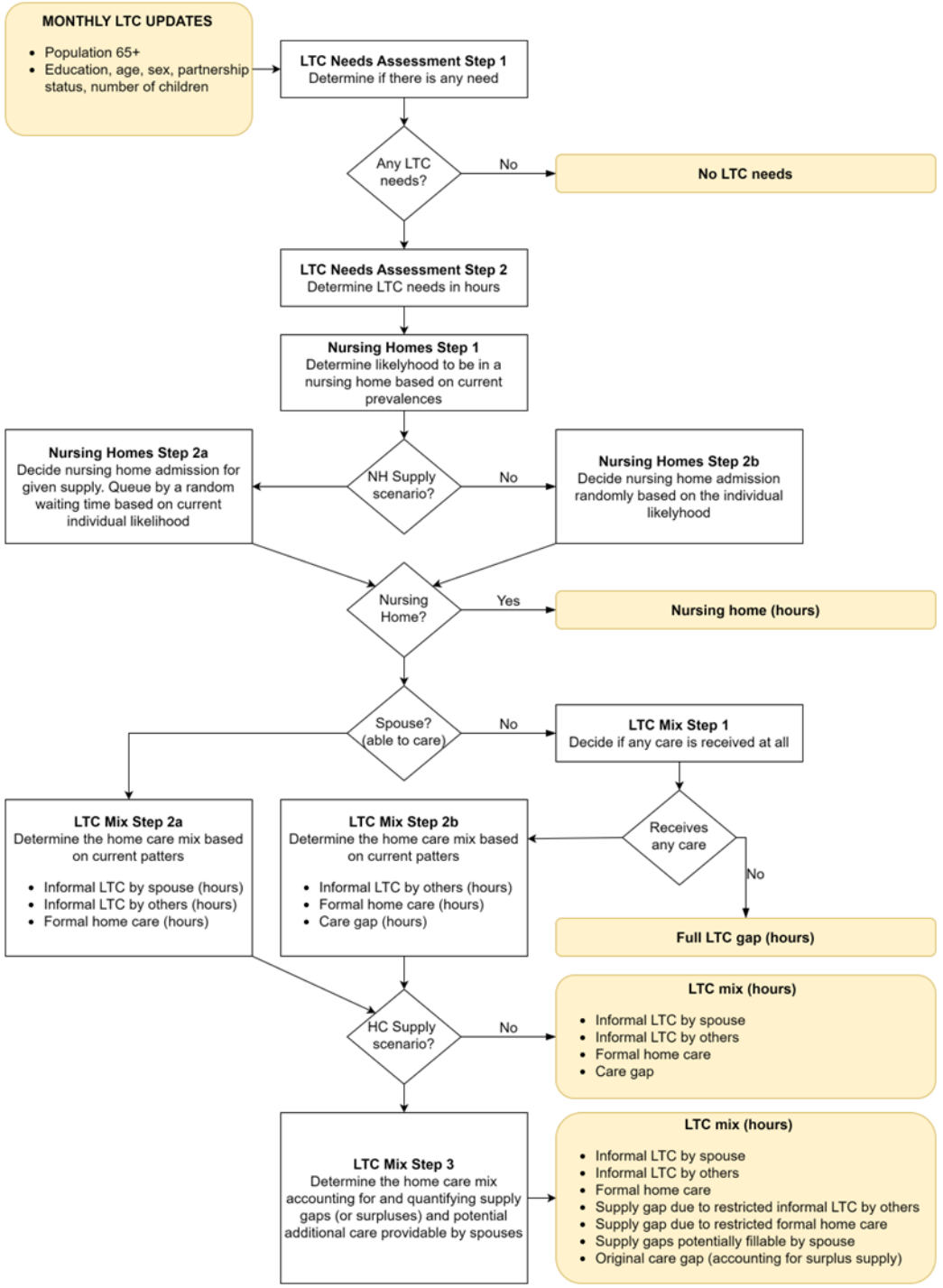
Long-Term CARE

- Imputation model for LTC needs in hours based on (I)ADLs reported in Share applying the Austrian care allowance assessment scheme
- Series of modelling / simulation steps
  - Needs y/n
  - Needs in h
  - Decision home-care – nursing home
  - Home-care mix
- Supply restrictions
  - Nursing home places
  - Formal home care hours
  - Informal care by others than a spouse



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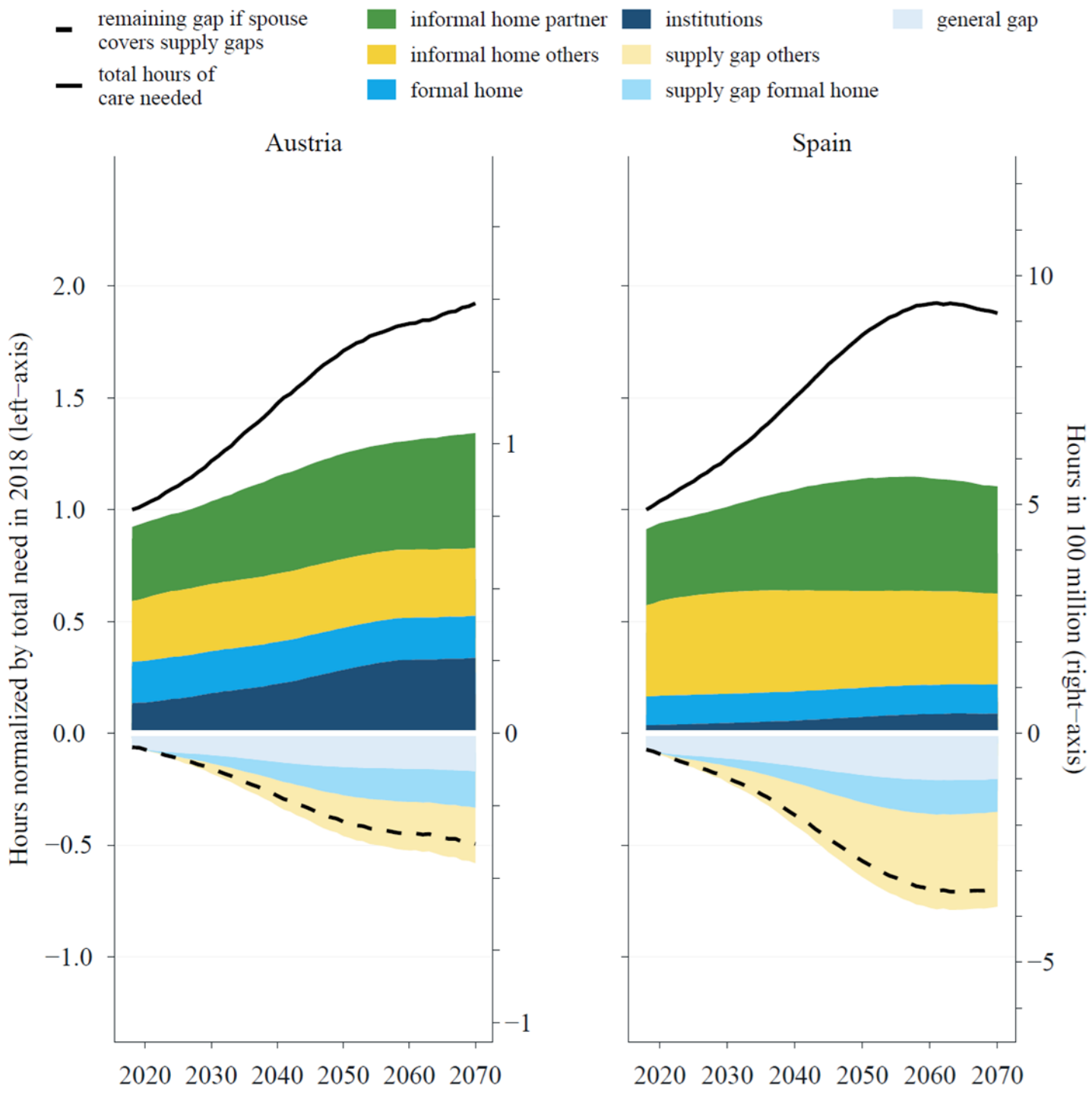
Scenario example

- Nursing homes: expansion to meet increasing demands (keeping individual probabilities as of today)
- Formal home-care: freeze supply – identify hours not covered
- Informal home-care “others”: freeze supply to current observed supply by age and sex - identify hours not covered
- Informal home-care spouse: SHARE logic: they cover needs



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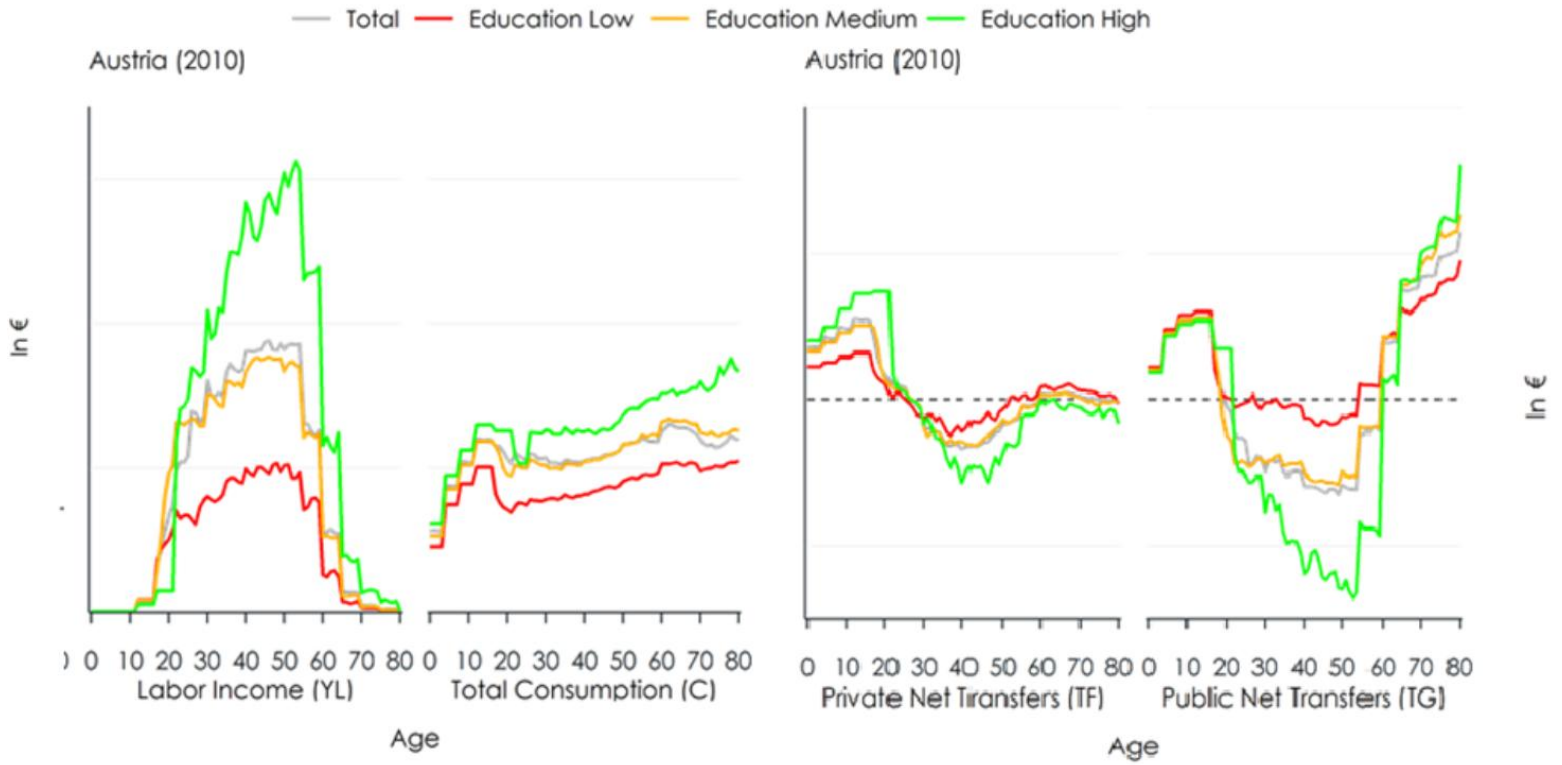
Modelling inspired by National Transfer Accounting (NTA) framework

- "Classic NTAs": National Accounts broken down to cross-sectional age-profiles

Microsimulation: modelled flows at the individual level.

Framework provides categories of

- Taxes
- Public and private transfers
- Public and private consumption



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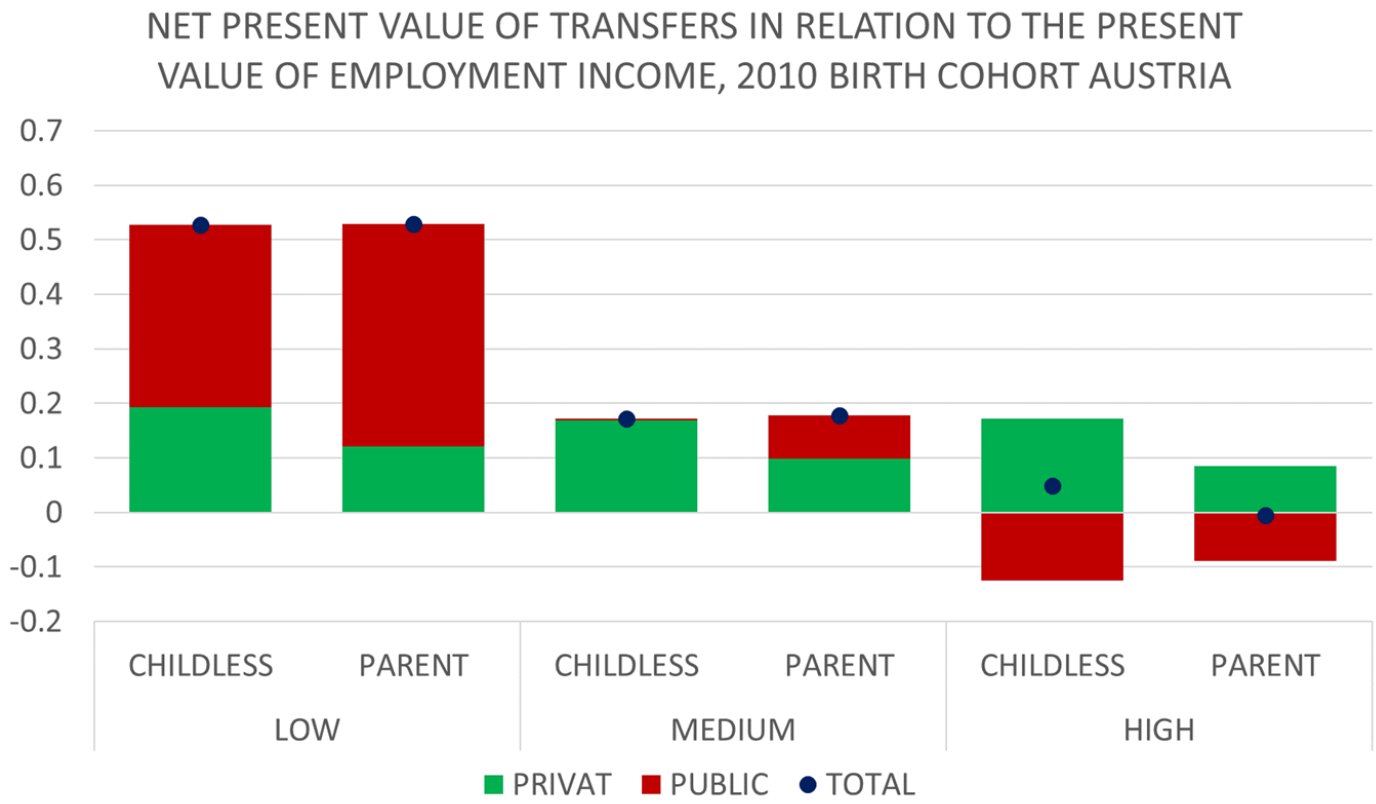
Example: Full Generational Accounts

Based on:

Lee, R., McCarthy, D., Sefton, J., Sambt, J. (2017), Full Generational Accounts: What Do We Give to the Next Generation? Population and Development Review 43(4): 695–720.

- Example: 1.5% growth, 3% discount factor, “symmetrically” balanced budgets.
- Private transfers: receive more than we give. Parents receive less
- Public transfers: only highest educational group net payers. Public transfers compensate for differences between parents and those without children.



Spielauer M., T. Horvath, M. Fink, G. Abio, G. Souto, C. Patxot, T. Istenič (2022) Measuring the Lifecycle Impact of Welfare State Policies in the Face of Ageing. Economic Analysis and Policy, 2022, 75, S.1-25

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Income and Transfers Modelled at Micro Level

Modelled incomes:

- Earnings: Mincer equations
- Pensions: stylized approach based on insurance duration, (potential) earnings at retirement.
- Maternal and parental leaves: take-up, duration, compensation
- Unemployment benefits: replacement by previous earnings, duration of coverage

Synthetic Tax-Benefit Calculator: Database of ~400k families based on all combinations of fine-grained family types, income levels, and income types - with corresponding tax-benefit information - generated by Euromod HHOT (Hypothetical Household) Tool.

- Exact matches (no searching of closest neighbor)
- Monetary values expressed in reference to average wage
- Separate modeling of income tax, social insurance contributions; Benefits following NTA categories (education, health, social, old-age related) -> allows some detail for adjustments to balance budgets

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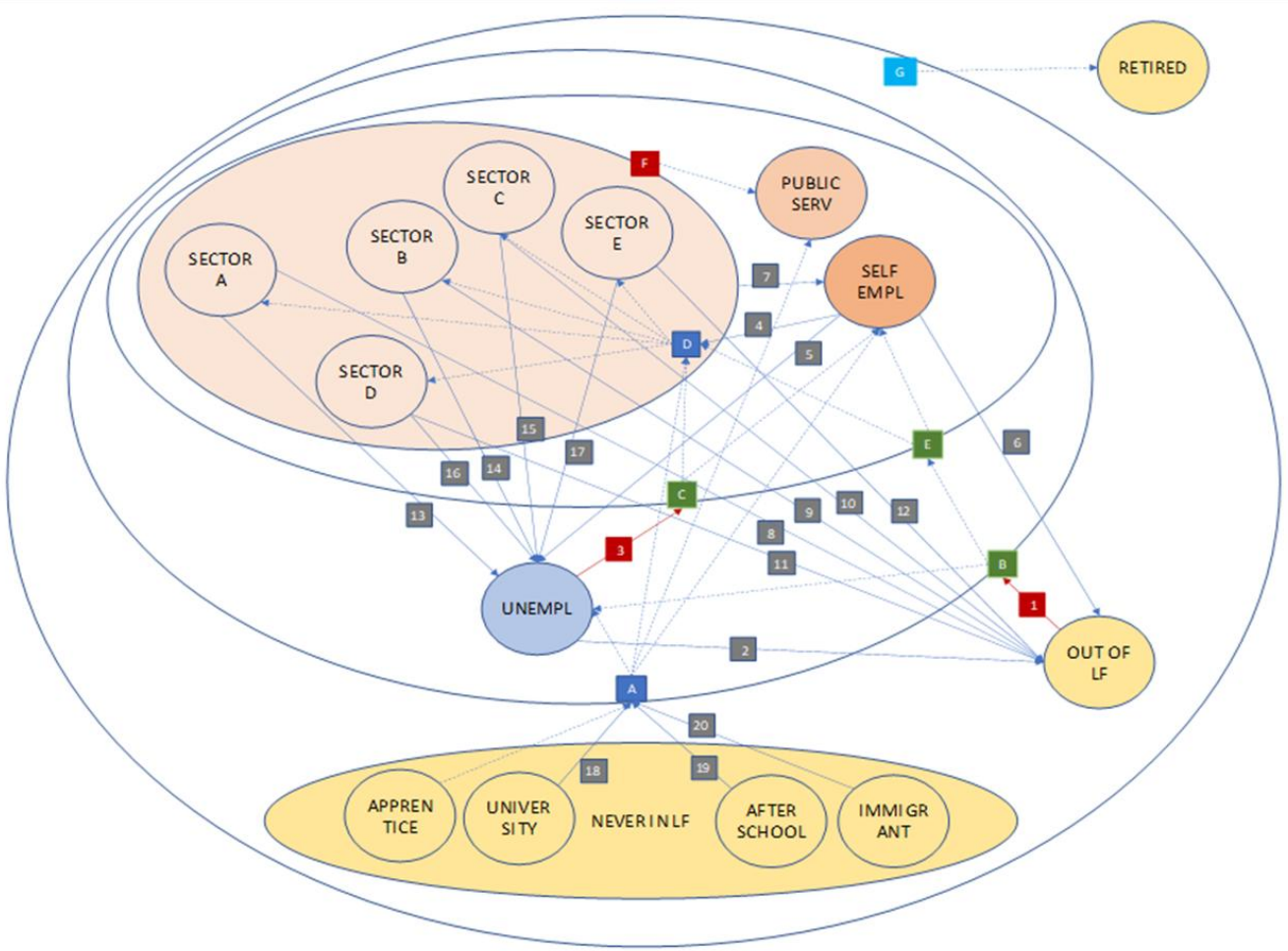
Longitudinal Careers: Activity Transitions

- Activity transitions mainly determined by hazard regressions: age, sex, education, family, health, duration in current state; economic sector
- Some transitions are “monitored” allowing for alignment to external targets a/o alternative models.
    - Unemployment -> Employment
    - Re-entry into labor-force
- Decision models, e.g., for placement into sector



Horvath, T., M. Spielauer, P. Warum (2025) Life Course Heterogeneity and the Future Labor Force - A Dynamic Microsimulation Analysis for Austria Vienna Yearbook of Population Research, 2025 Vol 23

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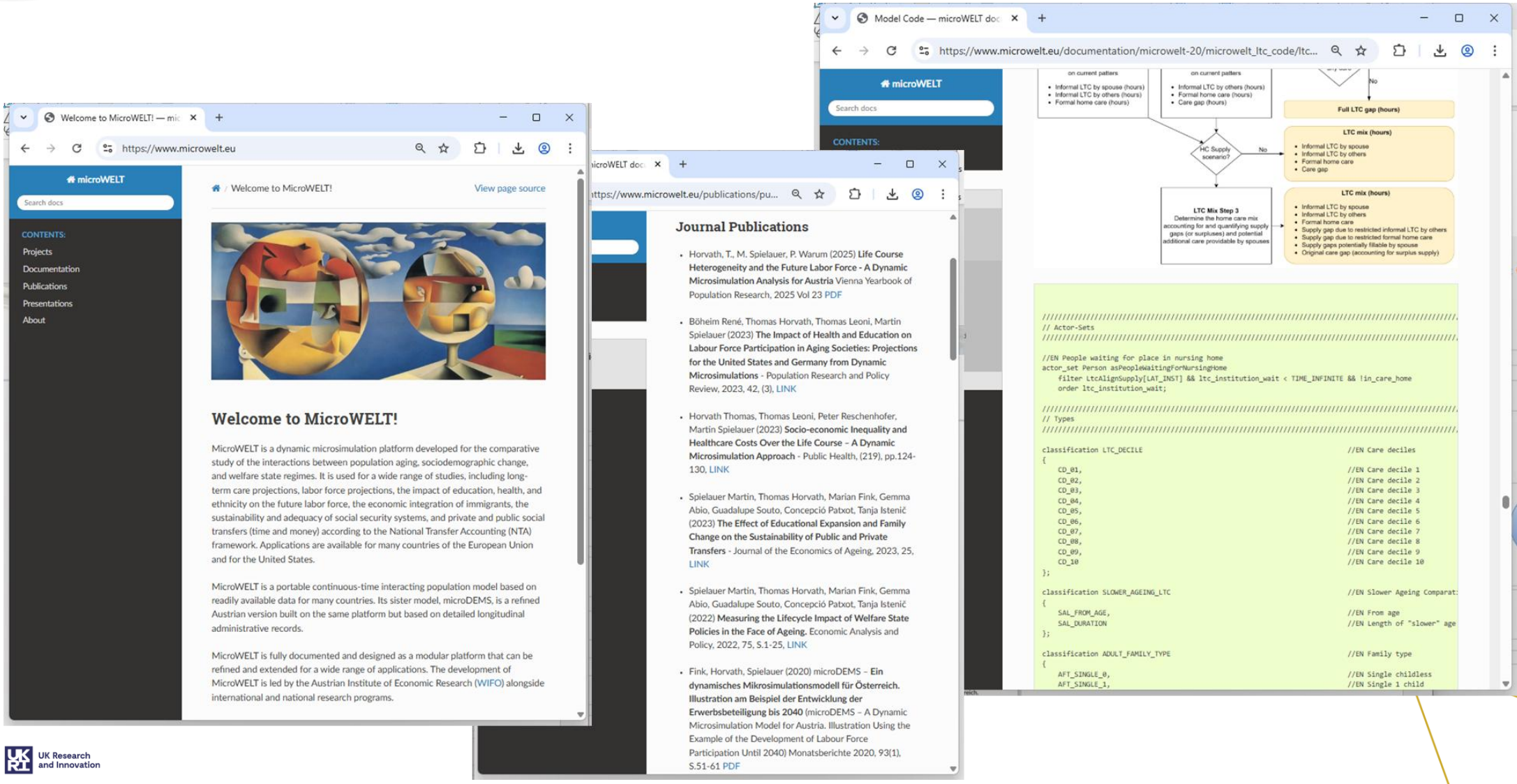

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