Pension Microsimulation Model ELSI

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Background

• In Finnish Centre for Pensions we have long tradition in doing long term pension projections with PTS macro model
  – Implemented using Dyalog APL
• The macro model gives good insight on pension expenditure and funding on system level
• No individual modeling
  – Not possible to get any distributional results on pension benefits

Hence, the need of microsimulation
Nice picture (PTS macro model)

Statutory pension expenditures
Per cent of GDP

Optimistic  Baseline  Pessimistic
Microsimulation

• (Harding & Gupta 2007):
  – “The defining characteristic of microsimulation models is that they analyse the likely behaviour of and the impact of policy change upon persons”
  – “the microdata usually contains thousands of individual or micro-unit records, with a host of variables describing the demographic, labour force, income and other characteristics of each individual”

• In dynamic microsimulation
  – The persons get older
  – Life events (death, working, retiring, education etc.) are simulated annually
Finnish pension system (the boring slide)

- Partially funded earnings related pension system (~90% of the pension expenditure)
- Pension accrues according to a fixed (age specific) percent of the earnings
  - Typically 1.5% of the earnings
  - No ceiling
- Various types of pension benefits:
  - Old age pension
  - Disability pension
  - Etc.
- Undergoing a major reform
ELSI model (1)

• A dynamic microsimulation model of the Finnish pension system
  – Based on register data
• Simulates 5% sample of the Finnish adult population 2009-2080
• 250 000 individuals in the starting year 2008
  – New eighteen-year-olds and immigrants added annually
  – Around 560 000 individuals in the whole simulation run
• Simulates working careers, earnings and finally pensions for each individuals
• One year time step
ELSI model (2)

• Results on pension benefits
  – Pension distributions
  – Replacement rates
  – Results on subpopulations
The model structure

- **PTS-model**
  - long-term macro projection

- **Transition probabilities**
  - labour markets
  - new pension recipients

- **Population forecast**
  - resident and non-resident population

- **National pension module**

- **Tax module**
  - taxation of pension and salary earnings

- **ELSI source data**
  - Finnish population
  - public and private sector workers
  - pensioners

- **Population module**
  - 250,000 individuals
  - 20 population states
  - education dynamics

- **Earnings module**
  - earnings dynamics

- **Earnings related pension module**
  - detailed pension calculation

- **Results**
  - output data
  - summary tables
  - distribution measures

- **Employment and earnings forecast**

- **Example module**
Why APL?

• Tradition
  – Compatibility with
    » The macro model
    » Population projection
    » Employment projection

• Flexibility
  – Modeling various proposals for a new pension scheme
  – Various results
On implementation

- The key modules are implemented using Dyalog APL
  - 12.1 and 14.0
- Some steps with start data and results also with SAS
  - SQAPL, ODBC
- The modules as independent as possible
- Macro results aligned to the PTS macro model
  - Micro-macro link
APL implementation (1)

- Module is implemented as a separate workspace
- The simulation data in component files
  - The output of a module is used as an input for the next module
  - No other links between the modules
- Each component file contains a component for each year (typically 77 years)
  - Each individual has 22 attributes each year
  - Alltogether more than 500,000 individuals in the simulation data
  - The size of a component file around 5GB
- The micro-macro link is also implemented using component files
APL implementation (2)

• Each module can be run separately
  – given the corresponding start data
• Each module run takes 10-40 mins (version 12.1)
Version 14.0

• Transition from 12.1 to 14.0
• Useful features
  – Compressing the components (to 16% of the original 5GB size)
  – Interpreter optimisation
  – Parallelisation (not yet implemented)
Examples of results
Replacement rate
68 year-olds pension distribution
In the near future

• Transition to version 14 completed
• Optimisation of the implementation
• Extending the model
Thanks for your attention!