An Introduction to MIDAS_BE: the dynamic microsimulation model for Belgium

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The budgetary costs of ageing in Europe

Change in gross public pension expenditure in EU27 member states between 2010-2060

Source: EC, 2012, the 2012 Ageing Report. table 2.5 page 101, 9.4
But what are we missing in this picture: financial and ‘social’ sustainability

• The sustainability and adequacy of pensions are two sides of the same coin
  Assumptions and projections underlying the assessment of sustainability affect adequacy
  productivity growth, wages, employment, the link between wages and benefits
  Not all aspects of the adequacy of pensions are reflected by the replacement rate or the benefit rate
  (re)distributional impact, poverty, the link between wages and benefits

• so...
  An assessment of the sustainability of pension systems should take into account the adequacy of pension benefits
Overview of this presentation
The social and budgetary impacts of recent social security reform in Belgium

1. Microsimulation: a birds-eye overview
2. The dynamic microsimulation model MIDAS (Microsimulation for the Development of Adequacy and Sustainability)
3. It takes two to tango: the relations between MIDAS and MALTESE
4. An application: recent social security reform in Belgium
   - Budgetary impact of social security reform
   - Social impact of social security reform
5. Conclusions
A discussion and classification of microsimulation models

• The essential function of (dynamic/static) microsimulation models...

...is the imputation of (prospective/alternative) microdata
A classification of microsimulation models

Static Models

- No ageing
- static ageing and uprating

Euromod, Misim
TARKI, STATION

Dynamic Models

Dataset: cohort vs. population

Simulation order: longitudinal vs. cross-sectional

Other discerning characteristics
- Time: discrete vs. continuous
- Marriage: open vs. close

MIMOSIS
Some dynamic cross-sectional ageing microsimulation models in governmental institutions

DYNACAN (Morrison, 2000),
POLISIM (McKay, 2003),
PENSIM2 (Emmerson, 2004),
the Sfb3 models (Galler and Wagner, 1986),
MOSART (Andreassen et al.et al., 1996),
PENMOD (Shiraishi, 2008)
SESIM (Ericson, and Hussnienius, 1999; Klevmarken and Lindgren, 2008)
MIDAS_BE (Dekkers et al, 2010)
MIDAS - Microsimulation for the Development of Adequacy and Sustainability

Starting dataset:
Previously: PSBH survey sample 2002: ±8K individuals
Currently: « MIMOSIS 2001 » administrative sample, expanded: ± 2.2K² individuals

DEMOGRAPHIC MODULE

LABOUR MARKET MODULE

PENSION & BENEFITS MODULE

CONTRIBUTIONS AND TAXATION MODULE

Mortality, fertility, education, marriage, market, employment, earnings, unemployment, poverty, inequality.
Shall we dance?

‘Channels of consistency’ of MIDAS with MALTESE

1. State alignment
2. Monetary alignment
3. Joint social hypotheses
The microsimulation model MIDAS: ready to dance

- **Alignment of state variables:**
  - Procedure to have the model respect or ‘mimic’ exogenous aggregates while respecting individual probabilities in the occurrence of the event
    - Behavioral equation determining the probability of the transition
    - Individuals are ranked depending on the obtained probability (from the highest to the lowest)
    - The number of selected individuals reproduces targeted aggregates

- **Monetary alignment or ‘amount alignment’:**
  - Proportional adjustment of first-run values of earnings to match exogenous macroeconomic productivity growth rates

- **Uprating**
  - Of social security benefits
# Assumptions and hypotheses of the Study Committee on Ageing

## Key demographic hypotheses

<table>
<thead>
<tr>
<th></th>
<th>2007</th>
<th>2030</th>
<th>2050</th>
<th>2060</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fertility</td>
<td>1.81</td>
<td>1.76</td>
<td>1.76</td>
<td>1.77</td>
</tr>
<tr>
<td>Life expectancy at birth</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Men</td>
<td>77.3</td>
<td>81.2</td>
<td>84.0</td>
<td>85.3</td>
</tr>
<tr>
<td>women</td>
<td>83.3</td>
<td>87.0</td>
<td>89.7</td>
<td>90.9</td>
</tr>
</tbody>
</table>

## Key macro hypotheses

<table>
<thead>
<tr>
<th></th>
<th>Up to 2011</th>
<th>2011-2014</th>
<th>≥ 2015</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yearly productivity</td>
<td>0.01%</td>
<td>1.28%</td>
<td>1.50%</td>
</tr>
<tr>
<td>Unemployment rate</td>
<td></td>
<td>14.75 in 2014</td>
<td>Decreasing towards 8%</td>
</tr>
</tbody>
</table>

## Social policy hypotheses

<table>
<thead>
<tr>
<th></th>
<th>2009-2010</th>
<th>≥ 2015</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wage ceiling</td>
<td>Current legislation</td>
<td>1.25%</td>
</tr>
<tr>
<td>Minimum right per working year</td>
<td></td>
<td>1.25%</td>
</tr>
<tr>
<td>Welfare adjustment non-lump-sum benefits</td>
<td></td>
<td>0.50%</td>
</tr>
<tr>
<td>Employed and self-employed</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Welfare adjustment of lump-sum benefits</td>
<td></td>
<td>1.00%</td>
</tr>
</tbody>
</table>
Commercial break: LIAM2

```python
weight = __parent__.fweight,
partner_id = -1,
civstate = 1,
collar = 0,
education_level = -1,
workstate = 5,
gender=choice(["True", "False"], [0.51, 0.49])
"

marriage:
- in_couple: "MARRIED or COHAB"
- to_couple: "if(age >= 18) and (age <= 90) and not in_couple,
  if(MALE, 
    logit_regr(0.0, align='al_p_mmst_m.csv'),
    logit_regr(0.0, align='al_p_mmst_f.csv'),
  False)"

# difficult_match: "abs(age - qgrpav(age, filter=to_couple and MALE),
  filter=to_couple and FEMALE)"

# inwork: "if((workstate > 0) and (workstate < 5))"

# partner id: "if has couple."
```
Intermezzo: MIDAS’ starting dataset

- Administrative data “MIMOSIS 2001”
  305,019 individuals.
  random draw of 100,000 individuals whose main place of residence is in Belgium on January 1\textsuperscript{st}, 2002
  extend the sample with all those that live in the same private household as those included in the first draw
  sample of administrative data, taken from the Datawarehouse Labour Market and Social Protection
Intermezzo: MIDAS’ starting dataset

• Advantages
  Considerably larger: representativeness, target groups
  Fewer missing values or nonresponse
  More credible retrospective information
  Gross earnings and incomes
  States are formally defined, and not self-assessed

• Disadvantages
  Secondary data - not for research purposes
  Missing values are not random; far from it
  Missing variables: level of education
Intermezzo: MIDAS’ starting dataset

• Missing level of education
• Previous: use static microsimulation techniques
  
  We know whether a (working) individual is a BCW or WCW.
  
  We know the educational attainment levels of BCW and WCW on the basis of the Labour Force Survey.
  
  Use a Monte-Carlo process to simulate level of education given gender and employment status.

• Latest version: use statistical multiple imputation techniques to impute data on educational attainment level from the EU-SILC

  1. Specify and estimate a multinominal logit of education attainment level on explanatory variables that are common in both datasets
  2. Replace each missing observation by m>1 values from a Monte Carlo simulation process
  3. Select randomly one imputed observation during the expansion process
An application: An assessment of recent social security reform in Belgium

- Belgium is ageing
- We (also) experience the economic crisis, resulting in a slowdown of GDP and the contribution base
  - Budgetary costs of ageing without reform would increase by 4.7% of GDP between 2011 and 2060
- Employment rate of older workers remains low in international perspective
- After a period of political stalemate, the Di Rupo administration introduced a number of measures in the law of December 28\textsuperscript{th}, 2011
  - Reduce the costs of the system by delaying early retirement
  - Increase the activity rate of older workers
- What are the consequences of this reform on the poverty risk among the elderly?
An application: Social Security Reform in Belgium

• Conditions for early retirement:
  Age condition gradually increases from 60 to 62 in 2016
  Minimum career length immediately increases from 35 to 38 years, and then gradually to 40 years in 2015
  Most civil servants now become subject to the same conditions as employees

• Adaptation of the rules for calculating the benefit
  Equivalent periods unemployed/UCA are now evaluated by the minimum right per career year
  The early-retirement penalty for self-employed is reduced and abandoned for those of 63 and older, or who have a long career.
  Regimes for specific civil servants (university professors!) are abandoned
  The pension benefit of all civil servants younger than 50 (1/1/2012) is now based on the last 10 years of the career
  Possibilities for ‘equivalent periods’ are extended for civil servants of 50 and older
  An overall cap of 5 years is introduced for equivalent periods (except for ‘thematic career breaks’)

Unemployment/Conventional Early Leavers’ scheme

• Unemployment
  Cohabiting with dependants, singles: 3rd period unemployment introduced after 3 years; benefit is a minimum
  Cohabiting: 2nd period becomes shorter
  Benefit increases from 60 to 65 of last earnings during the 1st period
  Benefit is decreasing over time during the 2nd period
  Age condition for seniority supplement: was 50 years of age and career of 20 years; now 55 years of age

• Conventional Early Leavers’ Scheme (CELS)
  Replaced by Unemployment with Company Allowance (UCA)
  Entry conditions restricted (minimum age from 58 to 60; career condition from 35 to 40 years)
  Part-time CELS abandoned
The impact of social security reform

Macroeconomics and labour market

Table 2 Labour market: base scenario (with reform) and impact of the structural reforms (difference between projection with and without reform in percentage point)

<table>
<thead>
<tr>
<th></th>
<th>Base scenario (with reforms)</th>
<th>Impact of reforms</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>2011 2030 2060</td>
<td>2030 2060</td>
</tr>
<tr>
<td>Participation rate (labour force(^a) in % of population 15-64 years)</td>
<td>72.7 74.2 74.5</td>
<td>1.0 1.0</td>
</tr>
<tr>
<td>15-54 years</td>
<td>76.5 75.6 75.6</td>
<td>-0.2 -0.1</td>
</tr>
<tr>
<td>55-64 years</td>
<td>52.9 64.0 64.9</td>
<td>5.8 6.2</td>
</tr>
<tr>
<td>Employment rate (total employment in % of population 15-64 years)</td>
<td>64.0 68.0 68.5</td>
<td>0.9 1.0</td>
</tr>
<tr>
<td>15-54 years</td>
<td>68.3 70.0 70.2</td>
<td>-0.2 -0.1</td>
</tr>
<tr>
<td>55-64 years</td>
<td>42.0 55.1 56.3</td>
<td>5.2 5.6</td>
</tr>
<tr>
<td>Unemployment rate (unemployment in % of labour force(^a))</td>
<td>11.9 8.5 8.0</td>
<td>0.1 0.0</td>
</tr>
<tr>
<td>CELS/UCA rate (% of potential labour force(^b) 50-64 years)</td>
<td>8.0 5.9 5.6</td>
<td>-1.5 -1.5</td>
</tr>
</tbody>
</table>

Table 3 Macroeconomic projection: base scenario (with reform) and impact of the structural reforms (difference between projection with and without reform in %)

<table>
<thead>
<tr>
<th></th>
<th>Base scenario (with reforms)</th>
<th>Impact of the reforms</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Average annual growth rates in real terms in %</td>
<td>Level in %</td>
</tr>
<tr>
<td>GDP</td>
<td>1.6 1.7 1.7</td>
<td>0.07 0.00 0.03 1.3 1.4</td>
</tr>
<tr>
<td>Productivity</td>
<td>1.1 1.5 1.3</td>
<td>0.00 0.00 0.00 0.0 0.0</td>
</tr>
<tr>
<td>Employment</td>
<td>0.5 0.2 0.3</td>
<td>0.07 0.00 0.03 1.3 1.4</td>
</tr>
</tbody>
</table>
### The impact of social security reform

#### Budgetary costs

Table 4  
Budgetary costs of ageing: base scenario of the Study Committee of Ageing (with reform) and impact of the reforms (difference between projection with and without reform), October 2012

<table>
<thead>
<tr>
<th>Components of the budgetary costs</th>
<th>Base scenario (with reforms)</th>
<th>Impact of reforms</th>
</tr>
</thead>
<tbody>
<tr>
<td>-----------------------------------</td>
<td>------</td>
<td>------</td>
</tr>
<tr>
<td>Pensions</td>
<td>9.9</td>
<td>13.6</td>
</tr>
<tr>
<td>- wage-earners</td>
<td>5.4</td>
<td>7.6</td>
</tr>
<tr>
<td>- self-employed</td>
<td>0.8</td>
<td>1.0</td>
</tr>
<tr>
<td>- civil servants</td>
<td>3.7</td>
<td>5.0</td>
</tr>
<tr>
<td>Health Care&lt;sup&gt;a&lt;/sup&gt;</td>
<td>8.0</td>
<td>9.4</td>
</tr>
<tr>
<td>Disability schemes</td>
<td>1.6</td>
<td>1.6</td>
</tr>
<tr>
<td>Unemployment&lt;sup&gt;b&lt;/sup&gt;</td>
<td>2.0</td>
<td>1.3</td>
</tr>
<tr>
<td>CELS/UCA</td>
<td>0.4</td>
<td>0.3</td>
</tr>
<tr>
<td>Children benefits</td>
<td>1.6</td>
<td>1.6</td>
</tr>
<tr>
<td>Other social expenditures</td>
<td>1.7</td>
<td>1.7</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>25.3</td>
<td>29.5</td>
</tr>
</tbody>
</table>

**Source:** High Council of Finance, Study Committee of Ageing, Yearly Report 2012

a. Public expenditure, inclusive long-term care.

b. Inclusive time credit and career breaks
The impact of social security reform

Budgetary costs

• CELS/UCA (-0.1%): reduction of beneficiaries

• Unemployment (-0.1%; especially in the long term): less career breaks, more importantly: lower benefits due to
  - Decrease of unemployment benefit with duration unemployment
  - Increased eligibility age for seniority supplement

• Pension (-0.2% middle term, -0.1% long term).
  - In the middle term the number of pensioners decreases
  - In the long term, these individuals will eventually retire and receive a higher pension benefit. In the systems of employees and self-employed, these effects cancel each other out, but in the civil servants’ scheme, costs will in the long run increase.
The impact of social security reform

Social impact

Risk of poverty rate of retirees by gender, in percent

- Male - with reform
- Female - with reform
- Male - without reform
- Female - without reform
The impact of social security reform

Social impact of pension reform

Development of the average net retirement benefits of pensioners, by gender (on the left) and of the average net equivalent income of pensioners, by gender (on the right), %
The impact of social security reform

Social impact of unemployment reform

Risk of poverty rate of unemployed computed at 70% of the equivalent income, by gender (men on the left and women on the right)
Conclusions

1. This paper assesses the sustainability and adequacy impact of recent social security reform in Belgium.
2. As a result of this reform, the budgetary costs of ageing are reduced by 0.3%-point GDP, evenly distributed between pensions, unemployment and CELS/UCA.
3. In amounts, the costs are reduced as well, but the picture is less clear-cut.
4. So the impact of the reform is mainly via the higher employment rate and the resulting higher GDP growth rate.
5. The risk of poverty of pensioners decreases as a result of the reform. This effect is faster for men than for women.
6. The poverty risk for (male!) unemployed increases considerably.
7. The reform thus reinforces the existing AROP profiles between the unemployed and retired.
8. Interested in microsimulation? You really ought to try LIAM2!
Finally, some literature available upon request

• **General:**

• **Simulation of reforms through MALTESE and MIDAS**

• **Imputation**
Thank you
köszönöm
Alignment versus ‘normal’ simulation

‘standard’ Monte Carlo simulation

\[ P_i = \text{logit}^{-1}(\beta X) \]

\[ U_i < P_i \]

State 1

State 2

Individual i

\[ U_i < 1 - P_i \]

Aligned simulation target x%

\[ \text{Rank}_i = \text{logit}^{-1}(\beta X + \varepsilon_i) \]

\[ \text{First } xN \text{ individual} \]

State 1

State 2

Rank 1...n

\[ \text{Other } (100-x)N \text{ individuals} \]
Monetary alignment

Monetary alignment target growth rate $g_{X_t}$

1. Simulate the model
   \[ y_i = \beta X_i + u_i \text{ (2001, t)} \]

2. Aggregate; calculate $g_Y$

3. Compare $g_Y$ and $g_X$ and calculate the correction for $t$
   \[ c_t = \frac{g_X}{g_Y} \]

4. Proportionally adapt individual earnings
   \[ c_t y_i = (\beta X_i + u_i) \times c_t \]