On the impact of indexation and demographic ageing on inequality among pensioners

(Validating MIDAS Belgium using a stylized model)

Gijs Dekkers

Federal Planning Bureau &
CESO, K.U.Leuven

Paper presented at the European workshop on dynamic microsimulation
Brussels, March 4-5, 2010
On the impact of indexation and demographic ageing on inequality among pensioners

**Starting point**
validation: “the comparison of the model’s results to counterpart values that are known or believed to be correct, or that are consistent with one’s assumptions, [or] other trustworthy models’ results” (Morrison, 2007, 5)

**Theses**
1. the long run development of inequality of pensions is driven by just a few factors
2. A very simple stylized model can therefore be used to validate the simulation results of a dynamic microsimulation model.
Overview of this presentation

1. A base stylized model for the inequality of pensions
2. Simulate a change of the indexation parameter, and the impact of the retirement age
3. Apply two ‘forms’ of demographic ageing
   - A ‘baby boom’ generation
   - Increasing longevity
4. Validation of the Belgian MIDAS model
The base model

Suppose
1. 100 individuals in time $t \geq 0$, each of a different age (so, $\text{age}_t = [0, ..., 100]$, $t = [0, ..., 100]$).
2. everybody retires at 60 and dies at 100,
3. the pension benefit at 60 equals € 100.
4. The model is expressed relative to wage growth, and pensions lag behind the development of wages with a constant fraction $\Psi$.

Then
\[
p_{0,\text{age}} = 100(1 - \Psi)^{\text{age}-60} \text{ when } t=0
\]
\[
P_{t,\text{age}} = \begin{cases} 
  p_0(1-\psi)^{(t)}, & \text{if } \text{age}_0 > 60 \\
  100(1-\psi)^{(t)-(60-\text{age}_0)}, & \text{if } \text{age}_0 < 60 \& \text{age} \geq 60
\end{cases} \tag{1}
\]
\[
G_{ini,t} = F\{P_{t,60}, \ldots, P_{t,\text{age}<60}, \ldots, P_{t,100}\} \tag{3}
\]
base model ($\Psi=1.25\%$)
A change of the indexation parameter $\psi$ in the period cht

$$P_{t,age}=\begin{cases} 
    p_0(1-\psi_1)^{(t)}, & \text{if} \quad (age_0 > 60) \& (t < cht) \\
    p_0(1-\psi_1)^{(cht)}(1-\psi_2)^{(t-cht)}, & \text{if} \quad (age_0 > 60) \& (t \geq cht) \\
    100(1-\psi_1)^{(t)-(60-age_0)}(1-\psi_2)^{(t-cht)}, & \text{if} \quad (age_0 < 60) \& (age \geq 60) \& ((60-age_0) < cht) \& (t < cht) \\
    100(1-\psi_1)^{(cht)}(1-\psi_2)^{(t-cht)}, & \text{if} \quad (age_0 < 60) \& (age \geq 60) \& ((60-age_0) \geq cht) \& (t \geq cht) \\
    100(1-\psi_1)^{(60-age_0)}, & \text{if} \quad age_0 < 60 \& age \geq 60 \& ((60-age_0) < cht) \& (t \geq cht)
\end{cases}$$

Federal Planning Bureau
Economic analyses and forecasts
$\Psi$ decreases from 1.8% to 1.25% in $t=20$
Demographic ageing I: a ‘baby boom generation’

Write the base model as

\[ F\{\Pi_t\} \text{ with } \Pi_t = \begin{bmatrix} P_{t,60} & \cdots & P_{t,\text{age}60} & \cdots & P_{t,100} \end{bmatrix} \text{ or } \begin{bmatrix} 1 & 0 & 0 \\ \cdot & \cdot & \cdot \\ 0 & 1 & 0 \\ \cdot & \cdot & \cdot \\ 0 & 0 & 1 \end{bmatrix} \]

A special case is

\[ Gini^w_t = F\{\Pi_t^w\} \]

And

\[ \Pi_t^w = \begin{bmatrix} P_{t,60} & \cdots & P_{t,\text{age}60} & \cdots & P_{t,100} \end{bmatrix} \]

\[ \begin{bmatrix} w_{t,60} & 0 & 0 \\ \cdot & \cdot & \cdot \\ 0 & w_{t,\text{age}60} & 0 \\ \cdot & \cdot & \cdot \\ 0 & 0 & w_{t,100} \end{bmatrix} \]

with \( w_{0,\text{age}0} \sim N(43,23) \) and \( w_{t,\text{age}} = w_{0,(\text{age}-t)} \)
Demographic ageing I: a ‘baby boom generation’

KDE of age at \( t \leq 50 \)

Source: PSBH, MIDAS starting dataset in 2002, and own calculations.
Demographic ageing I: a ‘baby boom generation’
Demographic ageing II: increasing longevity

\[ Gini_t = F\{P_{t,60}, \ldots, P_{t,age>60}, \ldots, P_{t,x}\} \]

(5)

With \( x=g(t) \) \( \forall \ t=[0, \ldots, 100]. \)

age of death \( x \) increases by 10 years, from 90 in period 0 to 100 in period 100.
Demographic ageing: impact of ageing on pension inequality: the compound effect of fertility shock and increasing life expectancy

![Graph showing the impact of different fertility shocks on pension inequality.](image)

- **psi=5%**
- **psi=2.5%**
- **psi=1.25%**
- **psi=0.5%**

Federal Planning Bureau
Economic analyses and forecasts
MIDAS Belgium

• An acronym for ‘Microsimulation for the Development of Adequacy and Sustainability’
• A dynamic microsimulation model with cross-sectional ageing
• Developed in the FP6 project AIM
• The aim is to simulate the consequences of the assumptions and projections of the AWG on the adequacy of pensions.
• MIDAS was simultaneously developed for Belgium, Germany and Italy, by teams from the FPB, DIW and ISAE.
• The starting dataset of MIDAS_BE is the PSBH cross-sectional dataset representing a population of all ages in 2002 (8,488 individuals)
• MIDAS simulates
  • demographics: fertility, mortality, education
  • labour market: work, unemployment, disability, retirement, private & public sector, ...
  • pension module, 1st pillar: employees’ pensions, civil servants’ pensions, self-employed minimum pensions, CELS, IGO
Validation of the results of MIDAS_Belgium
Conclusions

• the more pensions lag with the development of wages, the higher inequality of pensions at any point in time.

• the higher the retirement age, the lower the inequality of pensions.

• the higher the retirement age, the faster inequality of pensions reacts to changes of the lag parameter.

• The two underlying causes of demographic ageing each have a different impact on the inequality of pensions.

• Besides a difference in base levels and a sluggish reaction of inequality to a change in the indexation parameter, the results of the simulation results of the stylized model seem to validate the results of MIDAS_BE.