Fixed versus Contingent Indexation: Welfare Implications

Alessandro Bucciol

Roel Beetsma

September 2009

Universiteit van Amsterdam

Amsterdam School of Economics

Motivation

- Many countries adopt, or are considering to adopt, a funded social security system
- Opponents argue that such systems leave individuals all the burden of demographic, financial and economic shocks
  - Pension buffers fluctuate
  - Hence, participants face changes in benefit indexation (workers/retirees) and/or
  - changes in contribution rates (workers)
- Retirees and workers near retirement are hurt most by changes in indexation

Motivation

- **Can we obtain welfare improvement under cohort-specific changes in indexation?**
- We investigate this by simulating an OLG model with a pension system like in the Netherlands
- The Dutch system is particularly vulnerable to shocks in demographic, financial and economic variables

Dutch Social Security

- Dutch social security system:
  1. **PAYG pillar** (everybody eligible)
  2. **Funded pillar** (mandatory for most employees)
  3. **Funded pillar** (voluntary)

- Peculiarity of the second pillar
  - very large
  - DB rather than DC

Vulnerability to Shocks

- The safety of future second-pillar pensions is indicated by the so-called **funding ratio**

$$F_t = \frac{A_t}{L_t} = \frac{\text{contributions}_t \text{ - benefits}_t + \left(1 + r_t^f\right)\text{assets}_{t-1}}{\text{liabilities}_t}$$

- Shocks may push the ratio below a critical level
- The law requires fund managers to take remedial action to bring the funding ratio back to above this critical level

Institutional Framework

- Actions involve changing one or more parameters:
  1. **Indexation of accumulated rights**

$$M_{i,j,t} = (1-m_t)\left(\left(1+\omega_{i,j,t}\right)M_{i,j-1,t-1} + \mu Y_{i,j,t}\right)$$

Stock of nominal rights

Indexation parameter(s)

  2. **Contribution rates from labor income**

$$p^S_{i,j,t} = \theta^S_t Y_{i,j,t}$$

Contribution

Contribution rate

where $Y_{i,j,t}$ is *labor income in excess of the franchise*:

$$Y_{i,j,t} = \begin{cases} \max\left\{0, y_{i,j,t} - \lambda y_t\right\} & j \le R \\ 0 & j > R \end{cases}$$

Model Features

- Small open economy
- Two-pillar pension system
- Discrete time (one year)
- *75* cohorts alive at any given moment
- Intra-generational heterogeneity (*10* income groups)
- Only aggregate shocks

Types of Uncertainty

- **Demographics**
  Fertility rate; survival probability
- **Economics**
  Inflation rate; productivity growth
- **Finance**
  Bond, equity, and real estate returns;
  Swap and bond yield curve

First Pillar

- **Contributions during working age**

$$p^F_{i,j,t} = \begin{cases} 0 & y_{i,j,t} < \delta^l y_t \\ \theta^F_t \left(y_{i,j,t} - \delta^l y_t \right) & y_{i,j,t} \in \left[\delta^l y_t, \delta^u y_t \right] \\ \theta^F_t \left(\delta^u y_t - \delta^l y_t \right) & y_{i,j,t} > \delta^u y_t \end{cases}$$

- **Benefits at retirement**

$$b^F_t = \rho^F y_t$$

- *The poorest pay no contribution, but still receive benefits*
- *Parameters are set to ensure period-by-period budget balance*

Second Pillar

- **Contributions during working age**

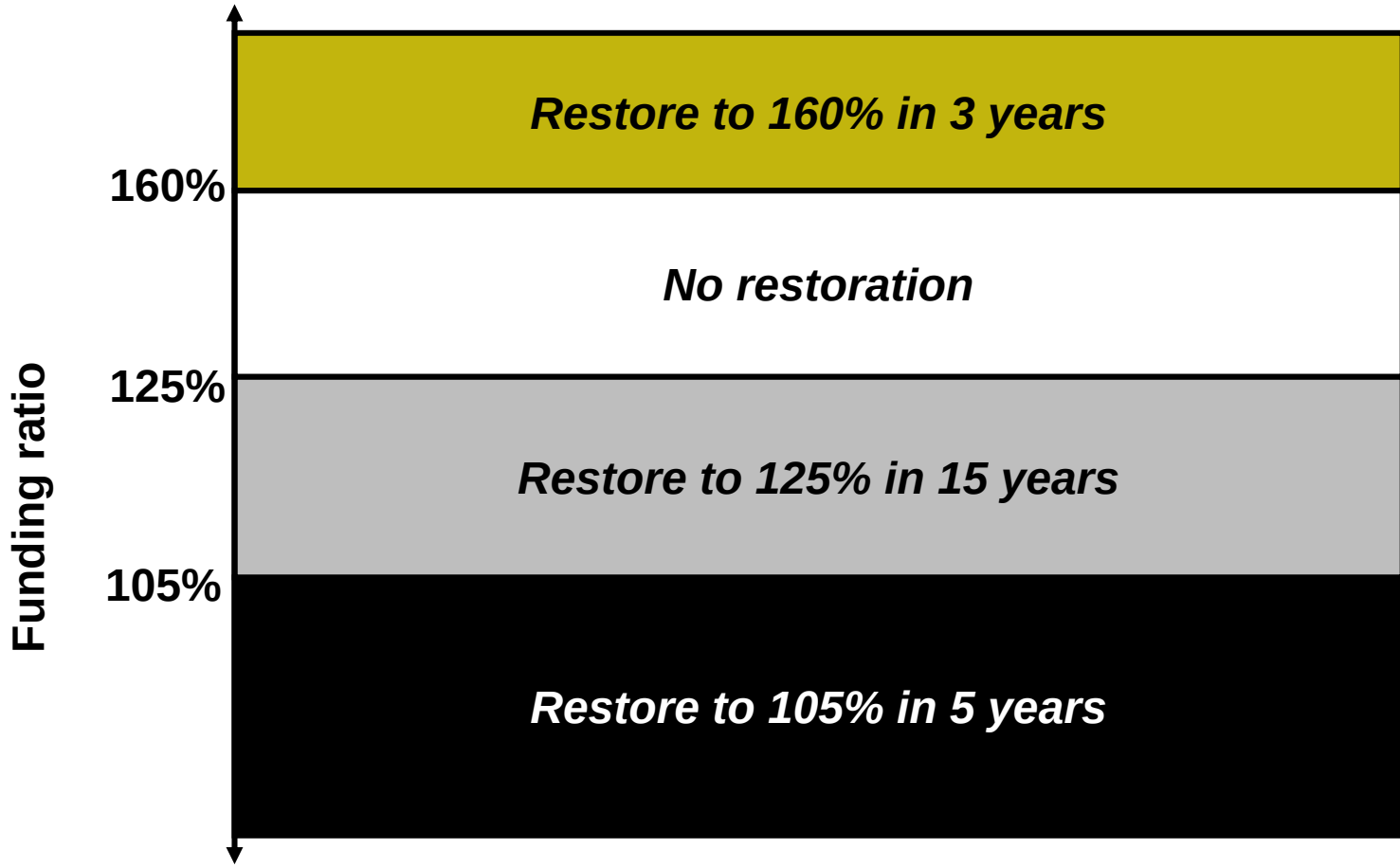
$$p^{S}_{i,j,t} = \theta^{S}_{t} Y_{i,j,t}$$

- **Benefits at retirement**

$$b^{S}_{i,j,t} = M_{i,j,t}$$

- *The poorest pay no contribution, and receive no benefit*
- *Parameters are set to keep the funding ratio stable*

Second Pillar Policy Rule



Indexation Policies

- **Uniform indexation**

$$\left(1+\omega_{i,j,t}\right)=\left(1+\iota_t\left(\frac{1+g_t}{1+\pi_t}-1\right)\right)\left(1+\kappa_t\pi_t\right)$$

- **Status-dependent indexation**

$$\left(1+\omega_{i,j,t}\right)=\begin{cases}\left(1+\iota_t\left(\frac{1+g_t}{1+\pi_t}-1\right)\right)\left(1+\kappa_t\pi_t\right) & j\le R\\ 1+g_t & j>R\end{cases}$$

Indexation Policies

- **Contingent indexation**

$$\left(1+\omega_{i,j,t}\right)=\left(1+g_t\right)$$
$$+\left(\left(1+\left(\iota_t-1\right)\left(\frac{1+g_t}{1+\pi_t}-1\right)\right)\left(1+\left(\kappa_t-1\right)\pi_t\right)-1\right)f\left(i,j,\tau\right)$$

$$f\left(i,j,\tau\right)=\begin{Bmatrix}1 & \tau=0\\ g\left(i,j\right) & \tau=1\end{Bmatrix}$$

Indexation Policies

- **Age-dependent indexation**

  The volatility of the indexation parameter is lower for cohorts with more nominal rights (older workers)

$$g(i,j) = \begin{cases} \alpha_1 - \alpha_2 \dfrac{\overline{M}_j}{\overline{\overline{M}}} & j \le R \\ 1 & j > R \end{cases}$$

- **Income-dependent indexation**

  The volatility is lower for poorer groups

$$g(i,j) = \begin{cases} \nu_1 - \nu_2 (I-1) & j \le R \\ 1 & j > R \end{cases}$$

Calibration: Social Security

- *Parameters are based on Dutch data and induce:*

- **First pillar**
  - Initial contribution rate: **16.42%**
  - Replacement rate: **30.40%**
- **Second pillar**
  - Initial indexation: full to price and productivity
  - Initial contribution rate: **17.58%**
  - Implied replacement rate: **37.60%**
  - Initial funding ratio: **140%**

Calibration: Shocks

- *Parameters are based on US historical data*

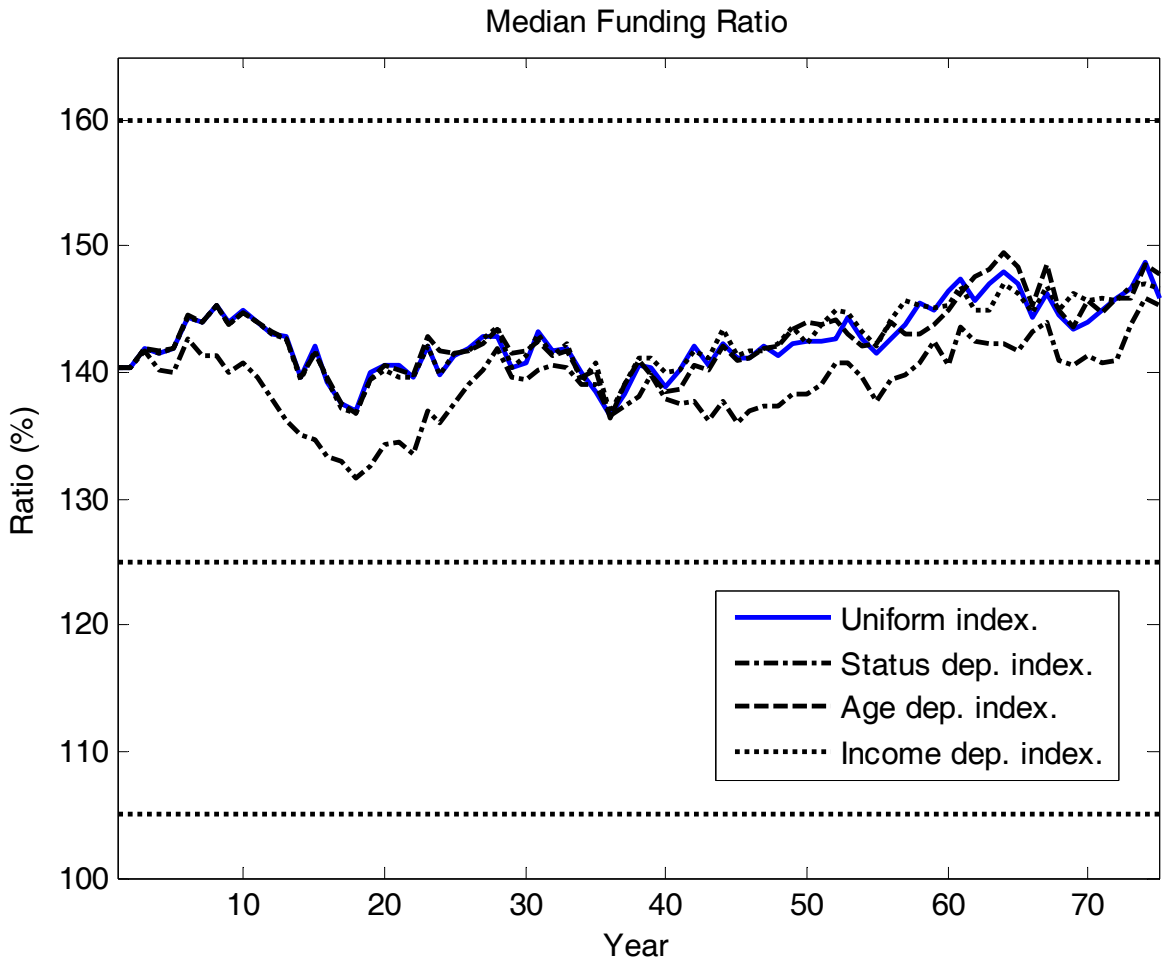
- Fertility rate: AR(1) model
- Survival probability: Lee-Carter model
- Inflation, productivity growth, bond, equity, RE returns:
  - Average from the literature
  - Covariances: VAR(1) model
- Swap and bond yield curve
  - VADL(1) model
  - normalization to the one-year bond return

Simulation Results

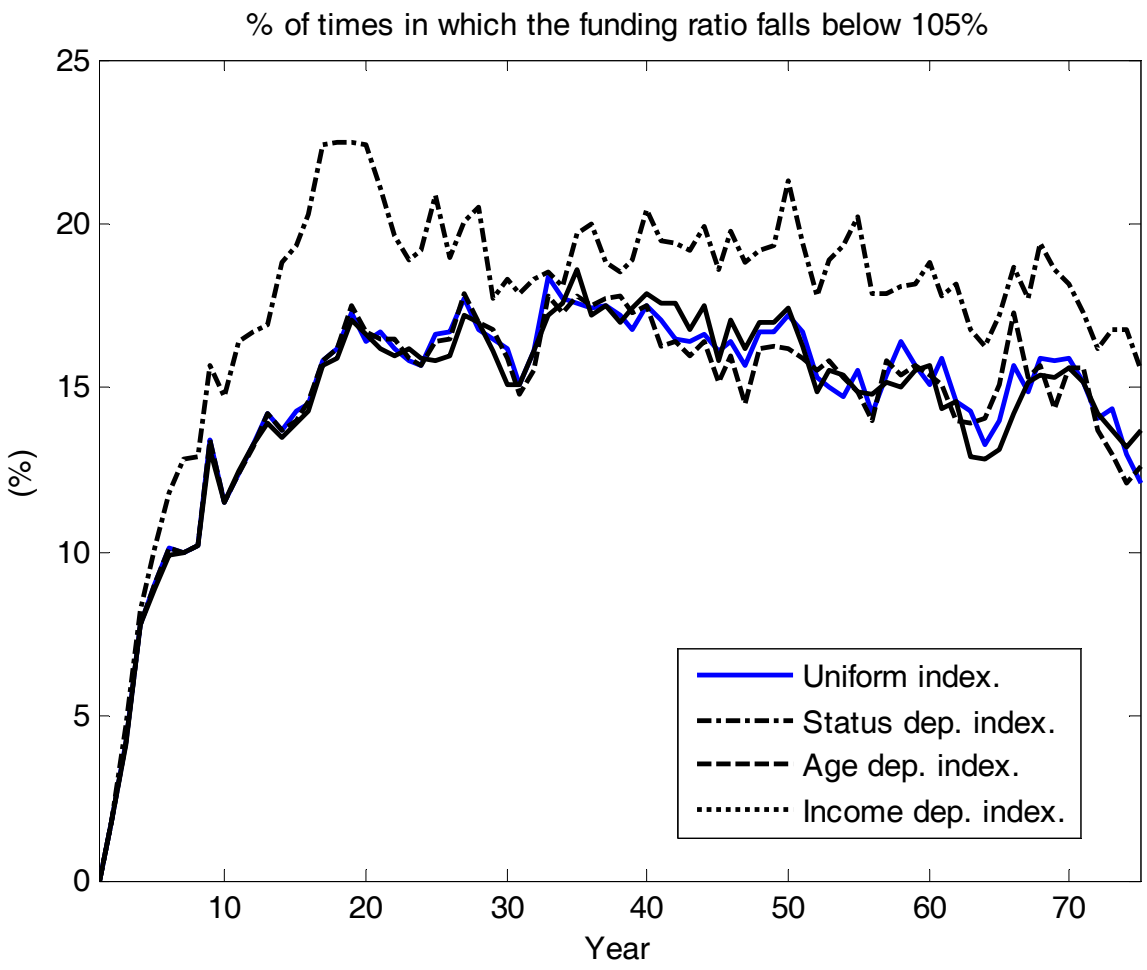
- 1,000 simulations of the random variables over 400 years
- Welfare obtained solving numerically the individual problem
  - Backward induction
  - Previous-year random variable realizations assumed to follow average path

    (to avoid curse of dimensionality)
  - Gauss-Legendre quadrature method over present-year innovations
  - State space discretized using a grid of 100 points
  - Linear extrapolation outside the grid

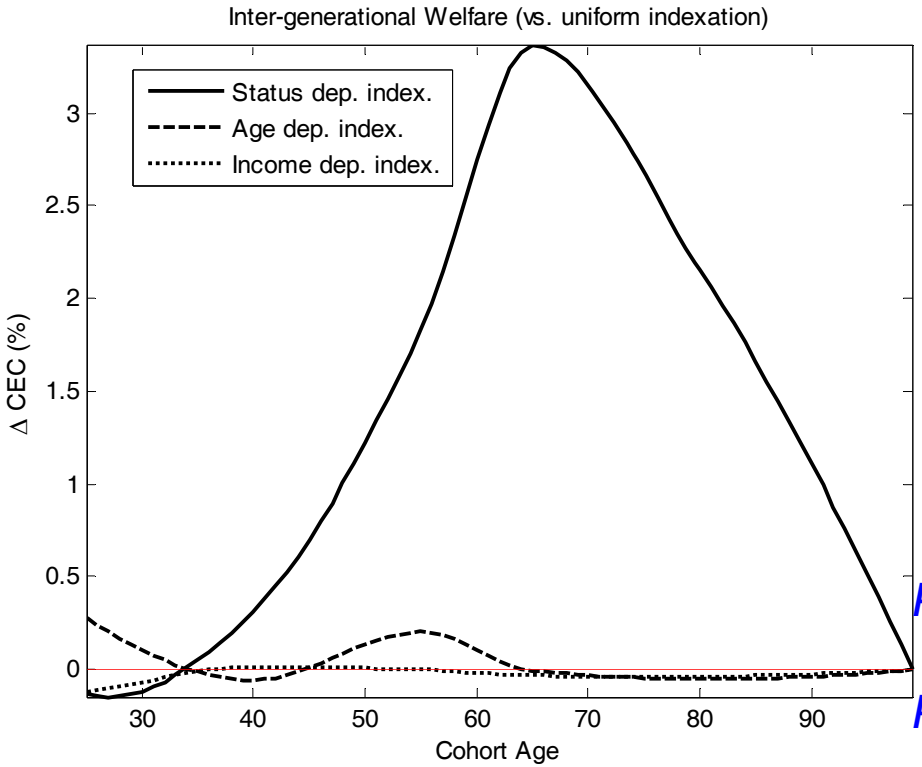
Funding Ratio



Funding Ratio Volatility



Welfare Comparison – All Policies

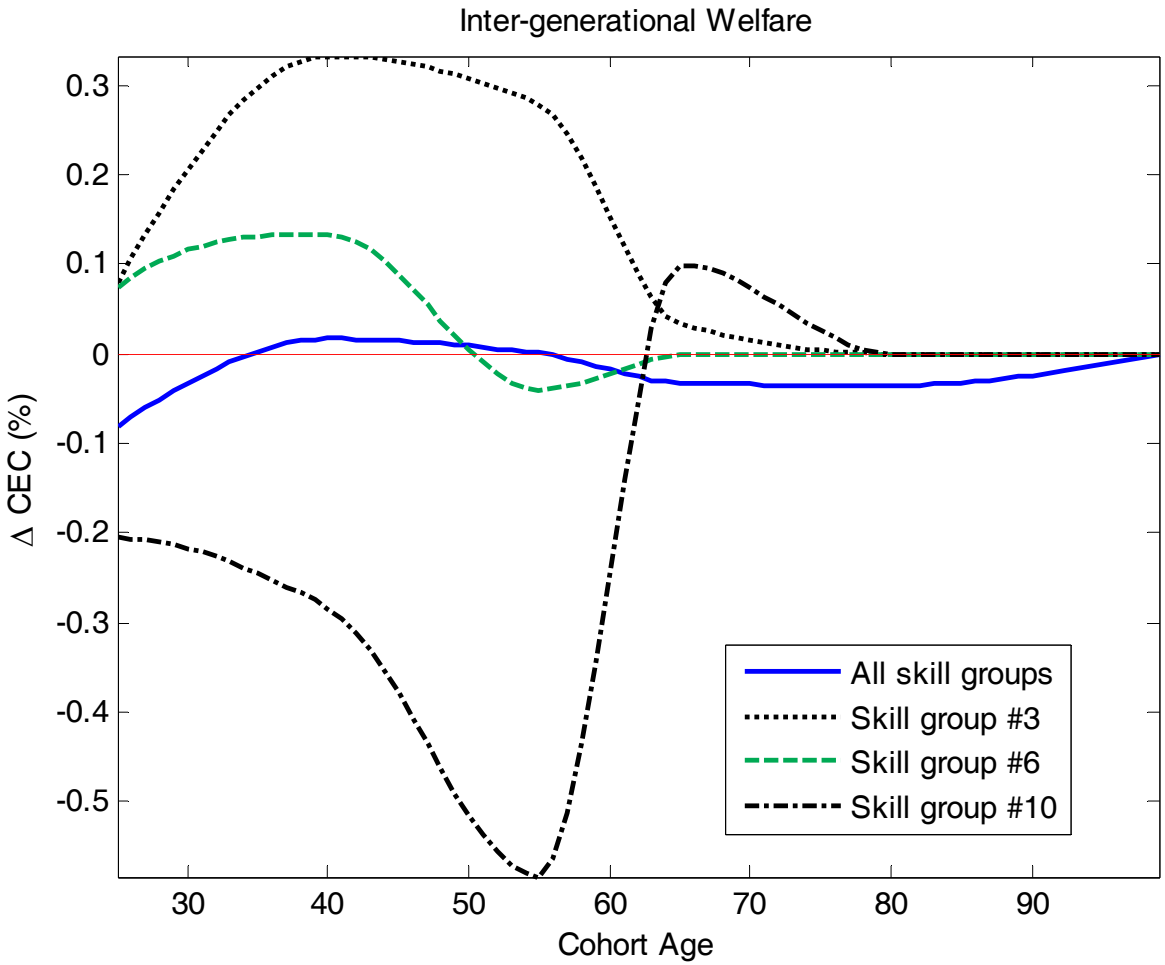


Prefer contingent indexation

Prefer uniform indexation

	Uniform	Status-dep.	Age-dep.	Income-dep.
D_1	-	**97.0924**	**63.1346**	**42.0818**
ΔC_1^A	-	**0.5950**	**-0.0674**	**0.0400**
ΔC_1^T	-	**-4.5956**	**-0.5419**	**-0.0885**

Welfare Comparison – Income-dep. Policy



Prefer contingent indexation

Prefer uniform indexation

Further Analyses

- Alternative policies
  - Fixed price indexation to the retirees
  - Age-income-dependent indexation
- Alternative maximum-minimum indexation spread
- Fund portfolio composition
  - Invest more in bonds when low funding ratio
  - Invest less in bonds when low funding ratio

- *The qualitative results are confirmed*

Summary

- Policy affects welfare and capability to prevent underfunding
- Status-dependent policy produces
  - lower and more volatile funding ratios
  - Welfare for initially alive cohorts, except the youngest
- Aggregate welfare effects of skill or age dependent indexation are very small
- Larger differences emerge among generations

Future Research

- Inflation-indexed bonds in the fund's portfolio
- Endogenous labor supply
  - Distortions caused by a change in contribution rates
- General equilibrium
  - Endogenize GDP
  - Endogenize wage, interest rates and equity returns