Pension reform in Belgium: a new points system between DB and DC

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Outline

1. Introduction
2. A new Points System
3. Between DB and DC: Musgrave rule
4. Risk sharing coefficient
5. Convex invariant
6. Future research
1. INTRODUCTION
Belgian pension in a nutshell

• **1° pillar**: *social security pension schemes*
  DB + PAYG
  *compulsory* social security

• **2° pillar**: *occupational pension schemes*
  DB/DC + funding
  *not compulsory* (employees: 70%)
  group insurance / pension funds

• **3° pillar**: *individual saving*
  Individual life insurances
Belgian pension in a nutshell

**Main challenges**

- Important increase of the cost in the next decades
  ( ... one of the main important in EU27 !!)

- First pillar not so generous for employees and surely not for self employed

- (Very) bad level of employment for people above 55
  ( culture of anticipated pensions)
Implicit equilibrium contribution rate

<table>
<thead>
<tr>
<th>Category</th>
<th>2011</th>
<th>2020</th>
<th>2030</th>
<th>2040</th>
</tr>
</thead>
<tbody>
<tr>
<td>Employees</td>
<td>20.4%</td>
<td>24.6%</td>
<td>29.7%</td>
<td>32.5%</td>
</tr>
<tr>
<td>Self employed</td>
<td>18.2%</td>
<td>22.2%</td>
<td>26.7%</td>
<td>28.5%</td>
</tr>
<tr>
<td>Civil Servants</td>
<td>56%</td>
<td>67.8%</td>
<td>80.7%</td>
<td>87.8%</td>
</tr>
</tbody>
</table>

(Source: Bureau Fédéral du plan – 2013)
2.A NEW POINTS SYSTEM
Proposition of a points system

4 main features:

- **PAYG** financing
- Benefit computation: *points* system
- Risk sharing between DB and DC
  (inspired by the *Musgrave Rule*)
- Universal system for the 3 categories
  (civil servants, employees, self-employed)
  but with different parameters

http://pension2040.belgium.be
Proposition of a points system
BEFORE RETIREMENT

Each year, during the active career:

\[ n_t = \frac{S_t}{S_r^t} \]

where: \( n_t \) = number of points for year \( t \)
\( S_t \) = individual salary of year \( t \)
\( S_r^t \) = reference salary of year \( t \)
Proposition of a points system

AT RETIREMENT AGE

Total number of points at retirement:
\[ N_T = \sum_{t=T-M}^{T} n_t \]

Conversion of the points at retirement age:
\[ P_T = N_T \cdot V_T \cdot \rho_T \]

where:
- \( N_T \) = total number of points
- \( V_T \) = value of the point (in €)
- \( \rho_T \) = actuarial coefficient (age/career)
Proposition of a points system

Value of the point - DB

**Assumption:** representative agent:
- salary equal to the reference salary each year
- working period = reference period N* (no actuarial correction)

Pension in a DB framework:

\[ P_T = N^* \cdot V_T = \delta \cdot S_T^r \]

with \( \delta = \) fixed replacement rate

\[ V_T = \frac{\delta \cdot S_T^r}{N^*} \]
Proposition of a points system

Value of the point - NDC

\[ P = \frac{1}{a_{65}} \cdot \sum_{t=T-45}^{T} \pi S_t \cdot g(t, T) \]

where:
- \( P \) = pension
- \( T \) = retirement year
- \( S_t \) = salary of year \( t \) (with ceiling)
- \( \pi \) = contribution rate (fixed)
- \( g(t, T) \) = revalorization based on notional rates
- \( a_{65} \) = annuity price at retirement age

\[ V_T = \frac{\pi S_T^r}{a_{65}} \]
3. BETWEEN DB AND DC: THE MUSGRAVE RULE
Automatic Adjustment

- initial dependence ratio: \( D_1 = \frac{\text{number of retirees}}{\text{number of contributors}} \)

- initial replacement rate: \( \delta_1 = \frac{\text{pension}}{\text{salary}} \)

- initial contribution rate: \( \pi_1 = \frac{\text{contribution}}{\text{salary}} \)

- uniform salary: \( S \)

- Pension equations: 
  \[
  D_1 \cdot P_T = \pi_1 \cdot S_T \\
  P_T = \delta_1 \cdot S_T
  \]

- Pension equilibrium: 
  \[
  \pi_1 = D_1 \cdot \delta_1
  \]
Automatic Adjustment

Automatic adjustment in case of change of the dependence ratio

if: $D_1 \rightarrow D_2$
then: $\delta_1 \rightarrow \delta_2 = ?$
$\pi_1 \rightarrow \pi_2 = ?$

Equilibrium condition:
$\pi_2 = D_2 \cdot \delta_2$
Automatic Adjustment

**DB**

\[
\delta_2 = \delta_1 = \delta \\
\pi_2 = \pi_1 \cdot \frac{D_2}{D_1}
\]

All the risk for the contributors

**DC**

\[
\pi_2 = \pi_1 = \pi \\
\delta_2 = \delta_1 \cdot \frac{D_1}{D_2}
\]

All the risk for the retirees
Musgrave rule

Invariant in DB: \( \delta_2 = \delta_1 = \delta \)

Invariant in DC: \( \pi_2 = \pi_1 = \pi \)

Invariant in Musgrave:

\[
M_1 = \frac{\delta_1}{1 - \pi_1} = \frac{\delta_2}{1 - \pi_2} = M_2
\]

Risks borne by contributors AND retirees

\[
\delta_2 = \delta_1 \cdot \frac{1}{1 + \delta_1 \cdot (D_2 - D_1)}
\]

\[
\pi_2 = \pi_1 \cdot \frac{D_2}{D_1 + \pi_1 \cdot (D_2 - D_1)}
\]
Musgrave Rule
Numerical illustration

- initial dependence ratio: \( D = 0.40 \)
- initial replacement rate: \( \delta = 0.50 \)
- initial contribution rate: \( \pi = 0.40 \times 0.50 = 0.20 \)

<table>
<thead>
<tr>
<th></th>
<th>( D_2 = 0.25 )</th>
<th>( D_2 = 0.35 )</th>
<th>( D_2 = 0.45 )</th>
<th>( D_2 = 0.50 )</th>
<th>( D_2 = 0.60 )</th>
</tr>
</thead>
<tbody>
<tr>
<td>DB</td>
<td>( \delta )</td>
<td>0.50</td>
<td>0.50</td>
<td>0.50</td>
<td>0.50</td>
</tr>
<tr>
<td></td>
<td>( \pi )</td>
<td>0.13</td>
<td>0.18</td>
<td>0.23</td>
<td>0.25</td>
</tr>
<tr>
<td>DC</td>
<td>( \delta )</td>
<td>0.80</td>
<td>0.57</td>
<td>0.44</td>
<td>0.40</td>
</tr>
<tr>
<td></td>
<td>( \pi )</td>
<td>0.20</td>
<td>0.20</td>
<td>0.20</td>
<td>0.20</td>
</tr>
<tr>
<td>DM</td>
<td>( \delta )</td>
<td>0.54</td>
<td>0.51</td>
<td>0.49</td>
<td>0.48</td>
</tr>
<tr>
<td></td>
<td>( \pi )</td>
<td>0.14</td>
<td>0.18</td>
<td>0.22</td>
<td>0.24</td>
</tr>
</tbody>
</table>
4. RISK SHARING COEFFICIENT
General risk sharing

\[
\begin{align*}
\text{if } & D_1 \rightarrow D_2 \\
\text{then } & \delta_1 \rightarrow \delta_2 = ? \\
& \pi_1 \rightarrow \pi_2 = ?
\end{align*}
\]

*DB* and *DC* can be seen as extreme solutions. *Musgrave* is one example of intermediate scheme.

\[\rightarrow Other \text{ possible solutions ?}\]

**Purpose**: develop a whole family of *mixed schemes* based on some *invariant* and leading to automatic risk sharing between generations.
Risk sharing coefficient

if: $D_1 \rightarrow D_2$
then: $\delta_1 \rightarrow \delta_2 = \delta_1 (1 - \lambda_\delta)$
       $\pi_1 \rightarrow \pi_2 = \pi_1 (1 + \lambda_\pi)$

Equilibrium condition gives:

$$(1 + \lambda_\pi) = \frac{D_2}{D_1} \cdot (1 - \lambda_\delta)$$

Definition: *Risk sharing coefficient*

$$\rho = \frac{\lambda_\pi}{\lambda_\delta} = \frac{\text{effort of the contributors}}{\text{effort of the retirees}}$$
Risk sharing coefficient

Limit cases:

a) DB: $\rho = +\infty$

b) DC: $\rho = 0$

In general: $\rho \in [0, +\infty]$

Musgrave: *risk sharing coefficient not invariant:*

$$\rho = \frac{1}{\pi} - 1$$

Example:

$\pi_1 = 20\% \rightarrow \rho_1 = 4$

$\pi_2 = 24\% \rightarrow \rho_2 = 3.17$
Risk sharing coefficient

Other possible sharing mechanism:

\[ \rho = \text{constant} = "\text{level of solidarity of the contributors}" \]

\[
\begin{align*}
\pi_2 &= \pi_1 \cdot \frac{D_2 \cdot (1 + \rho)}{D_2 + \rho \cdot D_1} \\
\delta_2 &= \delta_1 \cdot \frac{D_1 \cdot (1 + \rho)}{D_2 + \rho \cdot D_1}
\end{align*}
\]

Example: \( \rho = 1 \): equal sharing
### Numerical illustration

<table>
<thead>
<tr>
<th></th>
<th>D₂=0,25</th>
<th>D₂=0,35</th>
<th>D₂=0,45</th>
<th>D₂=0,50</th>
<th>D₂=0,60</th>
</tr>
</thead>
<tbody>
<tr>
<td>ρ=0</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(DC)</td>
<td>δ</td>
<td>0.8</td>
<td>0.57</td>
<td>0.44</td>
<td>0.40</td>
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<tr>
<td></td>
<td>π</td>
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<td>ρ=0.5</td>
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<tr>
<td></td>
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<tr>
<td></td>
<td>π</td>
<td>0.17</td>
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<td>ρ=1</td>
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<tr>
<td>(DE)</td>
<td>δ</td>
<td>0.62</td>
<td>0.53</td>
<td>0.47</td>
<td>0.44</td>
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<tr>
<td></td>
<td>π</td>
<td>0.15</td>
<td>0.19</td>
<td>0.21</td>
<td>0.22</td>
</tr>
<tr>
<td>ρ=4</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>(DM)</td>
<td>δ</td>
<td>0.54</td>
<td>0.51</td>
<td>0.49</td>
<td>0.48</td>
</tr>
<tr>
<td></td>
<td>π</td>
<td>0.14</td>
<td>0.18</td>
<td>0.22</td>
<td>0.24</td>
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<tr>
<td>ρ=20</td>
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<td></td>
<td>δ</td>
<td>0.51</td>
<td>0.50</td>
<td>0.50</td>
<td>0.49</td>
</tr>
<tr>
<td></td>
<td>π</td>
<td>0.13</td>
<td>0.18</td>
<td>0.22</td>
<td>0.25</td>
</tr>
<tr>
<td>ρ = +∞</td>
<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>(DB)</td>
<td>δ</td>
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<td>0.50</td>
<td>0.50</td>
<td>0.50</td>
</tr>
<tr>
<td></td>
<td>π</td>
<td>0.13</td>
<td>0.18</td>
<td>0.23</td>
<td>0.25</td>
</tr>
</tbody>
</table>
5. CONVEX INVARIANT
Musgrave revisited

- **Musgrave invariant**:

\[ M = \frac{\delta}{1 - \pi} \]

Or:

\[ \frac{1}{1+M} \cdot \delta + \frac{M}{1+M} \cdot \pi = \frac{M}{1+M} \]

Or:

\[ \alpha \cdot \delta + (1 - \alpha) \cdot \pi = \frac{M}{1+M} = \text{constant} \]

with \( 0 \leq \alpha \leq 1 \)

Example: \( \pi = 20\% ; \delta = 50\% \rightarrow \alpha = 0.62 \)
Convex invariant

Definition: **Convex invariant risk sharing:**

\[ \alpha \delta + (1 - \alpha) \pi = \text{constant} \]

for some \( 0 \leq \alpha \leq 1 \)

Limit cases:

a) DB: \( \alpha = 1 \)

b) DC: \( \alpha = 0 \)
Convex invariant

Other possible sharing mechanism:

\[ \alpha = \text{constant} = "\text{level of solidarity of the contributors}" \]

\[ \delta_2 = \delta_1 \cdot \frac{\alpha + (1 - \alpha)D_1}{\alpha + (1 - \alpha)D_2} \]

\[ \pi_2 = \pi_1 \cdot \frac{D_2}{D_1} \cdot \frac{\alpha + (1 - \alpha)D_1}{\alpha + (1 - \alpha)D_2} \]

Example: \( \alpha = 0.5 \): equal proportion
2 different ways to define a level of solidarity and to generate a family of pension systems intermediate between DC and DB:

- ratio between variation of contributions and variation of benefits (coefficient $\rho$)
- fixed convex combination of contribution rate and replacement rate (coefficient $\alpha$)
Conclusion (2)

Link between the two coefficients:

\[ \rho = \frac{1}{D_1} \cdot \frac{\alpha}{1 - \alpha} \]

Corollary:

DB and DC schemes are the only ones having at the same time a constant value for the 2 coefficients (\( \alpha = 0 \) or \( \alpha = 1 \))!
6. FUTURE RESEARCH
## Future topics

- Optimal choice of mix between DB and DC; Comparison between the families
- Multi period model
- Stochastic model and stability – asymptotic results?
- Other risk factors than the dependence ratio
- Mix PAYG / funding + Mix DB / DC


THANK YOU

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