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

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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

	2011	2020	2030	2040
Employees	20,4%	24,6%	29,7%	32,5%
Self employed	18,2%	22,2%	26,7%	28,5%
Civil Servants	56%	67,8%	80,7%	87,8%

(Source : Bureau Fédéral du plan – 2013)

2.A NEW POINTS SYSTEM

Proposition of a points system

http://pension2040.belgium.be

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

Proposition of a points system BEFORE RETIREMENT

Each year , during the active career :

$$\boxed{n_t = \frac{S_t}{S_t^r}}$$

where : n_t = number of points for year t

S_t = individual salary of year t

S_t^r = reference salary of year t

Proposition of a points system
AT RETIREMENT AGE

Total number of points at retirement :

$$\boxed{N_T = \sum_{t=T-M}^{T} n_t}$$

Conversion of the points at retirement age :

$$\boxed{P_T = N_T . V_T . \rho_T}$$

where : N_T = total number of points

V_T = value of the point (in €)

ρ_T = actuarial coefficient(age / career)

Proposition of a points system

Value of the point - DB

<u>Assumption</u> : representative agent :

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

Pension in a DB framework :

$$\boxed{P_T = N^*.V_T = \delta.S_T^r} \longrightarrow \boxed{V_T = \frac{\delta.S_T^r}{N^*}}$$

with δ = fixed replacement rate

Proposition of a points system

Value of the point - NDC

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

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 : $D_1 = \dfrac{\text{number of retirees}}{\text{number of contributors}}$
- initial replacement rate : $\delta_1 = \dfrac{\text{pension}}{\text{salary}}$
- initial contribution rate : $\pi_1 = \dfrac{\text{contribution}}{\text{salary}}$
- uniform salary : S

- Pension equations :

$$D_1.P_T = \pi_1.S_T$$

$$P_T = \delta_1.S_T$$

- Pension equilibrium :

$$\boxed{\pi_1 = D_1.\delta_1}$$

Automatic Adjustment

<u>Automatic adjustment in case of change of the dependence ratio</u>

$$\text{if}: D_1 \rightarrow D_2$$

$$\text{then}: \ \delta_1 \rightarrow \delta_2 = ?$$

$$\pi_1 \rightarrow \pi_2 = ?$$

Equilibrium condition :

$$\pi_2 = D_2 . \delta_2$$

Automatic Adjustment

DB

$$\delta_2 = \delta_1 = \delta$$

$$\pi_2 = \pi_1 . \frac{D_2}{D_1}$$

All the risk
for
the contributors

DC

$$\pi_2 = \pi_1 = \pi$$

$$\delta_2 = \delta_1 . \frac{D_1}{D_2}$$

All the risk
for
the retirees

Musgrave rule

<u>Invariant in DB</u> : $\delta_2 = \delta_1 = \delta$

<u>Invariant in DC</u> : $\pi_2 = \pi_1 = \pi$

<u>Invariant in Musgrave</u> :

$$\boxed{M_1 = \frac{\delta_1}{1-\pi_1} = \frac{\delta_2}{1-\pi_2} = M_2}$$

Risks borne by contributors AND retirees

$$\boxed{\delta_2 = \delta_1 . \frac{1}{1+\delta_1.(D_2 - D_1)}}$$

$$\boxed{\pi_2 = \pi_1 . \frac{D_2}{D_1 + \pi_1.(D_2 - D_1)}}$$

Musgrave Rule
Numerical illustration

- initial dependence ratio: D = 0.40
- initial replacement rate: δ = 0.50
- initial contribution rate : π = 0.40 x 0.50 = 0.20

		D_2=0,25	D_2=0,35	D_2=0,45	D_2=0,50	D_2=0,60
DB	δ	**0.50**	**0.50**	**0.50**	**0.50**	**0.50**
	π	0.13	0.18	0.23	0.25	0.30
DC	δ	**0.80**	**0.57**	**0.44**	**0.40**	**0.33**
	π	0.20	0.20	0.20	0.20	0.20
DM	δ	**0.54**	**0.51**	**0.49**	**0.48**	**0.45**
	π	0.14	0.18	0.22	0.24	0.27

4.RISK SHARING COEFFICIENT

General risk sharing

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

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

$\longrightarrow$ ***Other possible solutions*** ?

<u>Purpose</u> : develop a whole family of ***mixed schemes*** based on some ***invariant*** and leading to automatic risk sharing between generations

Risk sharing coefficient

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

Equilibrium condition gives :

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

<u>Definition</u> : ***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 :

$$\text{a) DB}: \ \rho = +\infty$$

$$\text{b) DC}: \ \rho = 0$$

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

Musgrave : *risk sharing coefficient not invariant*:

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

Example :

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

$$\pi_2 = 24\% \rightarrow \rho_2 = 3.17$$

Risk sharing coefficient

<u>Other possible sharing mechanism :</u>

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

$$\downarrow$$

$$\boxed{\begin{aligned} \pi_2 &= \pi_1 . \frac{D_2 . (1+\rho)}{D_2 + \rho . D_1} \\ \delta_2 &= \delta_1 . \frac{D_1 . (1+\rho)}{D_2 + \rho . D_1} \end{aligned}}$$

<u>Example</u> : $\rho = 1$: equal sharing

Numerical illustration

		D_2=0,25	D_2=0,35	D_2=0,45	D_2=0,50	D_2=0,60
ρ=0 (*DC*)	**δ**	**0.8**	**0.57**	**0.44**	**0.40**	**0.33**
	π	0.20	0.20	0.20	0.20	0.20
ρ=0.5	**δ**	**0.67**	**0.55**	**0.46**	**0.43**	**0.38**
	π	0.17	0.19	0.21	0.21	0.23
ρ=1 (*DE*)	**δ**	**0.62**	**0.53**	**0.47**	**0.44**	**0.40**
	π	0.15	0.19	0.21	0.22	0.24
ρ=4 (*DM*)	**δ**	**0.54**	**0.51**	**0.49**	**0.48**	**0.45**
	π	0.14	0.18	0.22	0.24	0.27
ρ=20	**δ**	**0.51**	**0.50**	**0.50**	**0.49**	**0.49**
	π	0.13	0.18	0.22	0.25	0.29
ρ = +∞ **(DB)**	**δ**	**0.50**	**0.50**	**0.50**	**0.50**	**0.50**
	π	0.13	0.18	0.23	0.25	0.30

5.CONVEX INVARIANT

Musgrave revisited

- <u>Musgrave invariant</u> :

$$M = \frac{\delta}{1-\pi}$$

Or :

$$\frac{1}{1+M}.\delta + \frac{M}{1+M}.\pi = \frac{M}{1+M}$$

Or :

$$\boxed{\alpha.\delta + (1-\alpha).\pi = \frac{M}{1+M} = \text{constant}}$$

with $0 \le \alpha \le 1$

Example : $\pi = 20\%$; $\delta = 50\% \rightarrow \alpha = 0.62$

Convex invariant

Definition : **Convex invariant risk sharing :**

$$\boxed{\alpha.\delta + (1-\alpha).\pi = \text{constant}}$$

$$\text{for some } \ 0 \le \alpha \le 1$$

<u>Limit cases :</u>

$$\text{a) DB}: \ \alpha = 1$$

$$\text{b) DC}: \ \alpha = 0$$

Convex invariant

<u>Other possible sharing mechanism :</u>

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

$$\boxed{\begin{aligned} \delta_2 &= \delta_1 . \frac{\alpha + (1-\alpha).D_1}{\alpha + (1-\alpha).D_2} \\ \pi_2 &= \pi_1 . \frac{D_2}{D_1} . \frac{\alpha + (1-\alpha).D_1}{\alpha + (1-\alpha).D_2} \end{aligned}}$$

<u>Example</u> : $\alpha = 0.5$: equal proportion

Conclusion (1)

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* ρ)
- fixed convex combination of contribution rate and replacement rate (*coefficient* α)

Conclusion (2)

<u>Link between the two coefficients :</u>

$$\rho = \frac{1}{D_1} \cdot \frac{\alpha}{1-\alpha}$$

<u>Corollary :</u>

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

REFERENCES

Borsch-Supan, A., A.Reil-Held and C.B.Wilke (2003) How to make a defined benefit system sustainable: the sustainability factor in the German Benefit Indexation formula. Discussion paper 37/2003, Mannheim Institute for the Economics of Aging

Commission 2020-2040 (2014) *Un contrat social performant et fiable*, http://pension2040.belgium.be/fr/

Devolder, P. (2010) Perspectives pour nos régimes de pension légale. *Revue Belge de Sécurité sociale* »,**4** ,p.597-614

European Commission (2014) *The 2015 Ageing Report*, European Economy 8/2014

Holzmann, R., E. Palmer and D. Robalino (2012) *Non-financial Defined Contribution Pension schemes in a changing Pension world*, Vol 1., Washington D.C., World Bank

Knell M. (2010) How automatic adjustment factors affect the internal rate of return of PAYG pension systems. *Journal of Pension Economics and Finance*, **9**(1),1-23

Musgrave, R. (1981) A reappraisal of social security finance. *Social Security financing*, Cambridge, MIT, p. 89–127.

THANK YOU

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