Dividing the pot

The impact of longevity

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Motivation

- Transition from DB to DC
- New pension system in the Netherlands, transition period 2023-2027
- Existing pension funds' collective wealth will be divided into individual pension wealth
- Calculations are based on the so-called "standard method"
    - Resembles current method of indexation and cut in pension payments dependent on funding ratio.
- We show the sensitivity of
    - different fund characteristics
    - economic circumstances
    - longevity risk

  on the division of the pension pot.

Transition output variables

- Pension wealth adjustment
  - Percentage change between individual assigned pension wealth in new contract and present value of entitlements in the existing DB contract.
- Pension payment adjustment
  - Percentage change between first pension payment in new contract and entitlement in the existing DB contract.
    - Assumption: "Assumed interest rate" = "Term structure of interest rates".
    - Therefore: "Pension payment adjustment" = "Pension wealth adjustment"

Division method

- Notation:
  - A_l built-up pension entitlements/rights for pension holders aged l.
  - F funding ratio at moment of transition
  - N smoothing horizon: $q(h)$ of the adjustment factor is applied to entitlement with horizon h.

$$q(h) \quad = \quad \frac{\min(h+1, N)}{N} = \left\{ \frac{1}{N}, \frac{2}{N}, \frac{3}{N}, ..., 1, 1, 1, ... \right\}.$$

  - x percentage long-term adjustment of entitlements
- "Standard method": entitlements will be adjusted such that the present value of the liabilities are equal to the funds' wealth while taking into account the smoothing period.

Division method

- Present value of entitlements of pension holder aged l is

$$VPV_l = \sum_{h=\max(L_P-l,0)}^{\infty} \frac{A_l p_l(h)}{(1+r(h))^h}$$

- Present value of the liabilities for a pension holder aged l after transition is given by

$$V_l(x) = \sum_{h=\max(L_P-l,0)}^{\infty} \frac{A_l p_l(h)(1+q(h)x)}{(1+r(h))^h}$$

where L_P is the retirement age, $r(h)$ the risk-free rate with maturity h and $p_l(h)$ the h-years (unisex) survival rate of an individual aged l.

- Pension wealth adjustment

$$\frac{V_l(x)}{VPV_l} - 1.$$

Division method

- Funding ratio equality, i.e. budget constraint, implies long-term adjustment factor x,

$$\sum_{l=L_M}^{\infty} n_l V_l(x) = F \sum_{l=L_M}^{\infty} n_l VPV_l$$

where L_M is the minimum age of the pension holders in the fund, n_l are the number of individuals aged l and $V_l(x)$ the assigned individual wealth after transition.

- This can be solved for the entitlement adjustment factor x

$$x = (F-1)\frac{\sum_{l=L_M}^{\infty}\sum_{h=\max(L_P-l,0)}^{\infty}\frac{A_l n_l p_l(h)}{(1+r(h))^h}}{\sum_{l=L_M}^{\infty}\sum_{h=\max(L_P-l,0)}^{\infty}\frac{A_l n_l p_l(h) q(h)}{(1+r(h))^h}}$$

- Note that when $N = 1$, $q(h) = 1$ and thus $x = F - 1$.

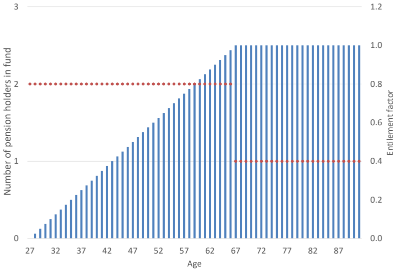
Input variables

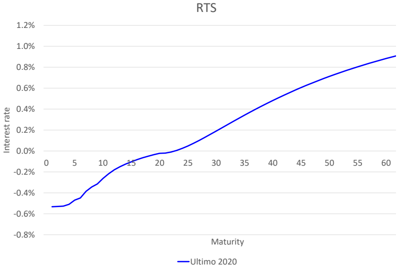
- Pension holders characteristics and entitlements
- Term structure of interest rates
- Smoothing period
- Initial funding ratio
- Survival probabilities

Base scenario

Table: Base scenario

Entitlements	$A = \{100, \forall l \in (67, 91), \frac{l-27}{40} 100, \forall l \in (27, \ldots, 66)\}$
Ages	$L_M = 27, L_P = 67, L_D = 91$
Duration D	20.2
Smoothing period N	10
UFR	1.78%
Funding ratio F	95%
Long-term adjustment x	-5.55%





Scenarios

- Fund characteristics
    1. Without smoothing
    2. Different funding ratios
    3. Green/gray fund
- Economic circumstances
    4. Increase/decrease term structure of interest rates for different degrees of hedging
- Longevity
    5. Increase/decrease in life expectancies

Scenarios

Table: Alternative scenarios

	$N=1$	$F=90\%$	$F=100\%$	$F=105\%$	Green	Gray
Duration D	20.2	20.2	20.2	20.2	25.1	14.8
Smoothing period N	1	10	10	10	10	10
Life expectancy	91	91	91	91	91	91
Funding ratio F	95%	90%	100%	105%	95%	95%
Long-term adjustment x	-5%	-11.10%	$+0\%$	$+5.55\%$	-5.36%	-6.18%

(a) Fund characteristics

	RTS $+1\%$			RTS -1%		
	Hedge 0%	Hedge 50%	Hedge 100%	Hedge 0%	Hedge 50%	Hedge 100%
Duration D	18.7	18.7	18.7	21.8	21.8	21.8
Smoothing period N	10	10	10	10	10	10
Life expectancy	91	91	91	91	91	91
Funding ratio F	115.3%	105.1%	95%	76.9%	86.0%	95%
Long-term adjustment x	$+17.3\%$	$+5.8\%$	-5.7%	-25.1%	-15.3%	-5.5%

(b) Economic circumstances

	F fixed		*Assets* fixed	
	Age 90	Age 92	Age 90	Age 92
Duration D	19.95	20.51	19.95	20.51
Smoothing period N	10	10	10	10
Life expectancy	90	92	90	92
Funding ratio F	95%	95%	99.66%	90.79%
Long-term adjustment x	-5.56%	-5.54%	-0.38%	-10.21%

(c) Longevity

Smoothing period

Table: Alternative scenarios

	$N = 1$	$F = 90\%$	$F = 100\%$	$F = 105\%$	Green	Gray
Duration D	20.2	20.2	20.2	20.2	25.1	14.8
Smoothing period N	1	10	10	10	10	10
Life expectancy	91	91	91	91	91	91
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	Age 90	Age 92	Age 90	Age 92
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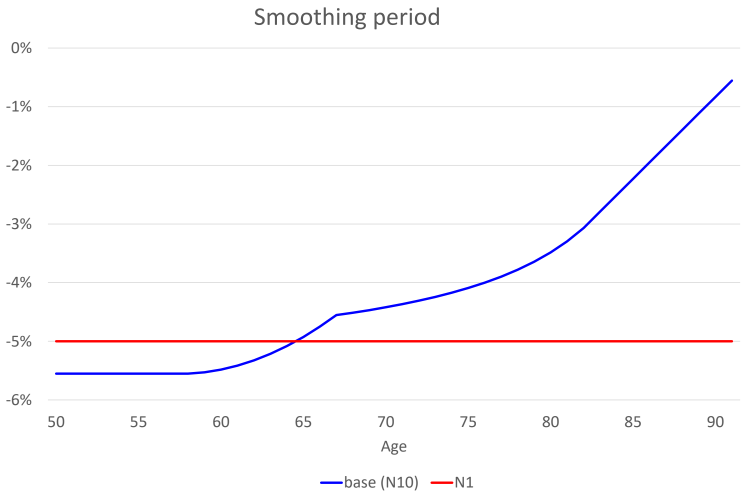
(c) Longevity

Smoothing period $N = 10$ versus $N = 1$



Base $x = -5.55\%$
$N = 1$, $x = -5\%$.

Funding ratios

Table: Alternative scenarios

	$N = 1$	$F = 90\%$	$F = 100\%$	$F = 105\%$	Green	Gray
Duration D	20.2	20.2	20.2	20.2	25.1	14.8
Smoothing period N	1	10	10	10	10	10
Life expectancy	91	91	91	91	91	91
Funding ratio F	95%	90%	100%	105%	95%	95%
Long-term adjustment x	−5%	−11.10%	+0%	+5.55%	−5.36%	−6.18%

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(b) Economic circumstances

	F fixed		*Assets* fixed	
	Age 90	Age 92	Age 90	Age 92
Duration D	19.95	20.51	19.95	20.51
Smoothing period N	10	10	10	10
Life expectancy	90	92	90	92
Funding ratio F	95%	95%	99.66%	90.79%
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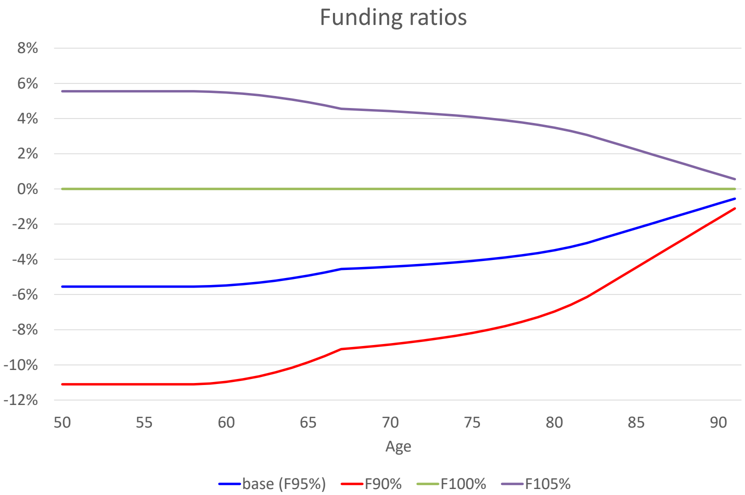
(c) Longevity

Funding ratios



Base $x = -5.55\%$
$F = 90\%$, $x = -11.10\%$
$F = 100\%$, $x = 0\%$
$F = 105\%$, $x = +5.55\%$.

Fund composition

Table: Alternative scenarios

	$N = 1$	$F = 90\%$	$F = 100\%$	$F = 105\%$	Green	Gray
Duration D	20.2	20.2	20.2	20.2	25.1	14.8
Smoothing period N	1	10	10	10	10	10
Life expectancy	91	91	91	91	91	91
Funding ratio F	95%	90%	100%	105%	95%	95%
Long-term adjustment x	−5%	−11.10%	+0%	+5.55%	−5.36%	−6.18%

(a) Fund characteristics

	RTS +1%			RTS −1%		
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Duration D	18.7	18.7	18.7	21.8	21.8	21.8
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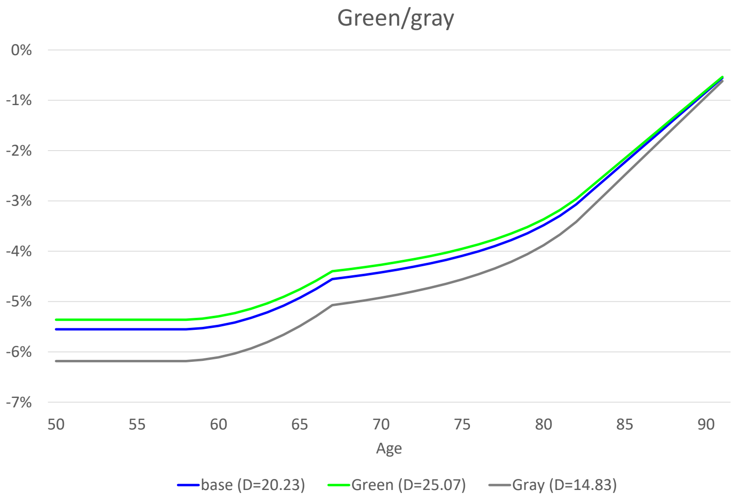
Long-term adjustment x	+17.3%	+5.8%	−5.7%	−25.1%	−15.3%	−5.5%

(b) Economic circumstances

	F fixed		*Assets* fixed	
	Age 90	Age 92	Age 90	Age 92
Duration D	19.95	20.51	19.95	20.51
Smoothing period N	10	10	10	10
Life expectancy	90	92	90	92
Funding ratio F	95%	95%	99.66%	90.79%
Long-term adjustment x	−5.56%	−5.54%	−0.38%	−10.21%

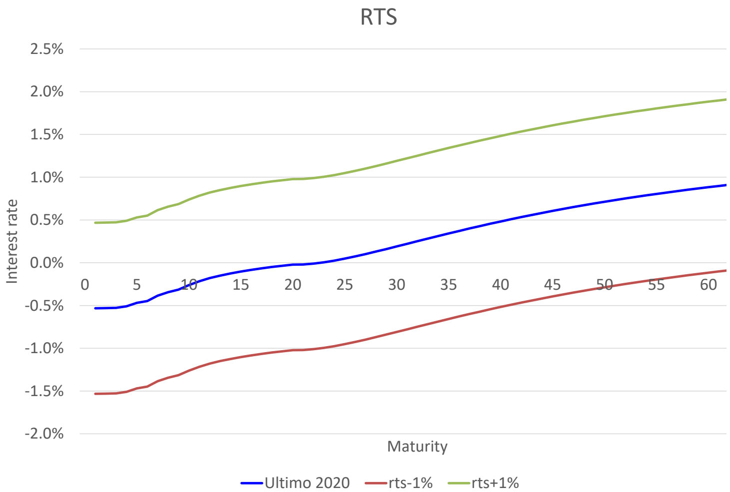
(c) Longevity

Green/gray



Base $x = -5.55\%$
Green $x = -5.36\%$, $n_l = 1, l \in (67, 91)$, $n_l = 2, l \in (51, 66)$ and $n_l = 6, l \in (27, 50)$
Gray $x = -6.18\%$, $n_l = 2, l \in (67, 91)$ and $n_l = 1, l \in (27, 66)$.

Term structure of interest rates



Interest rate increase

Table: Alternative scenarios

	$N = 1$	$F = 90\%$	$F = 100\%$	$F = 105\%$	Green	Gray
Duration D	20.2	20.2	20.2	20.2	25.1	14.8
Smoothing period N	1	10	10	10	10	10
Life expectancy	91	91	91	91	91	91
Funding ratio F	95%	90%	100%	105%	95%	95%
Long-term adjustment x	−5%	−11.10%	+0%	+5.55%	−5.36%	−6.18%

(a) Fund characteristics

	RTS +1%			RTS −1%		
	Hedge 0%	Hedge 50%	Hedge 100%	Hedge 0%	Hedge 50%	Hedge 100%
Duration D	18.7	18.7	18.7	21.8	21.8	21.8
Smoothing period N	10	10	10	10	10	10
Life expectancy	91	91	91	91	91	91
Funding ratio F	115.3%	105.1%	95%	76.9%	86.0%	95%
Long-term adjustment x	+17.3%	+5.8%	−5.7%	−25.1%	−15.3%	−5.5%

(b) Economic circumstances

	F fixed		*Assets* fixed	
	Age 90	Age 92	Age 90	Age 92
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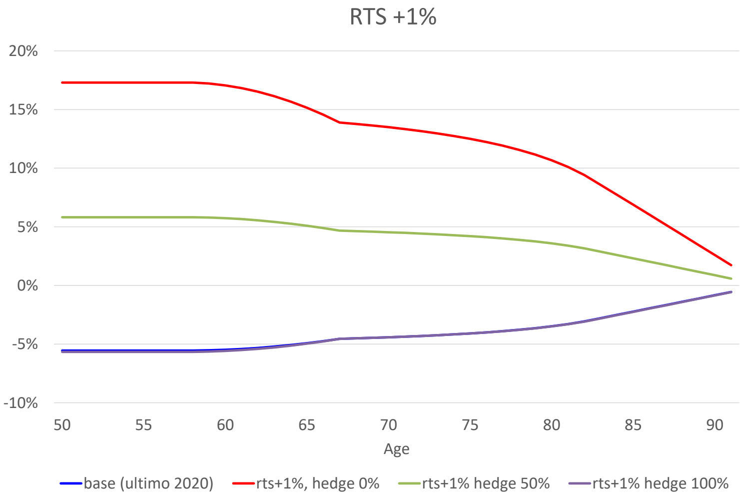
(c) Longevity

Interest rate increase



Base $x = -5.55\%$
Hedge 0%, $F = 115.3\%$, $x = +17.3\%$
Hedge 50%, $F = 105.1\%$, $x = +5.8\%$
Hedge 100%, $F = 95\%$, $x = -5.7\%$.

Interest rate decrease

Table: Alternative scenarios

	$N=1$	$F=90\%$	$F=100\%$	$F=105\%$	Green	Gray
Duration D	20.2	20.2	20.2	20.2	25.1	14.8
Smoothing period N	1	10	10	10	10	10
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Funding ratio F	95%	90%	100%	105%	95%	95%
Long-term adjustment x	−5%	−11.10%	+0%	+5.55%	−5.36%	−6.18%

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Long-term adjustment x	+17.3%	+5.8%	−5.7%	−25.1%	−15.3%	−5.45%

(b) Economic circumstances

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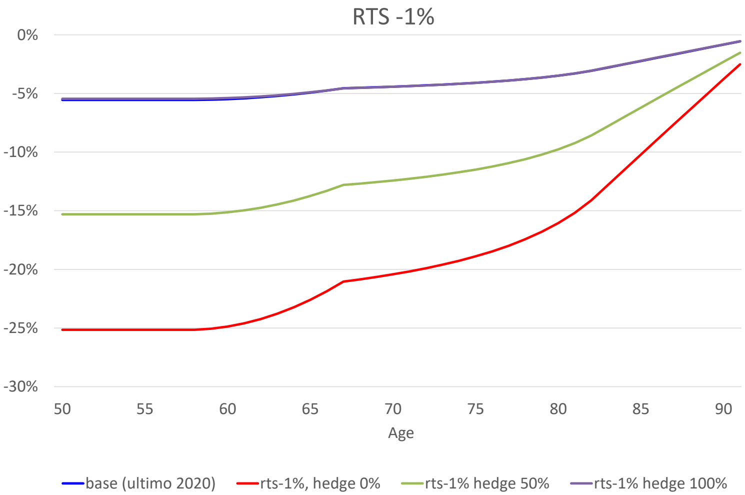
(c) Longevity

Interest rate decrease



Base $x = -5.55\%$
Hedge 0%, $F = 76.9\%$, $x = -25.1\%$
Hedge 50%, $F = 86.0\%$, $x = -15.3\%$
Hedge 100%, $F = 95\%$, $x = -5.45\%$.

Longevity

Table: Alternative scenarios

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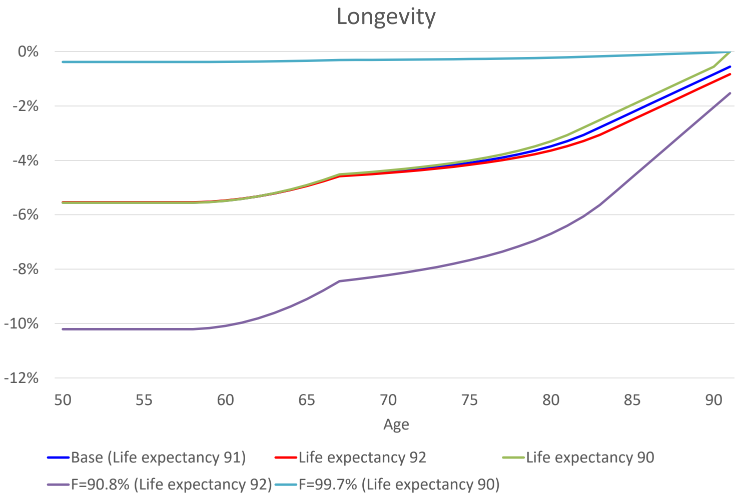
(c) Longevity

Longevity



Base $x = -5.55\%$
Age 90, $F = 95\%$, $x = -5.56\%$
Age 92, $F = 95\%$, $x = -5.54\%$
Age 90, $F = 99.66\%$, $x = -0.38\%$
Age 92, $F = 90.79\%$, $x = -10.21\%$.

Delay

- One-time transition, longevity risk goes along with delay.
- Delay in moment of transition concerns several effects:
  - There are less individuals per age (possibly in line with expectations) and all are older.
  - Higher entitlements but shorter duration and a few new entrants.
  - Change in life expectancies.
  - Change in interest rates.
  - Fund's asset values have changed.
- Complex interplay, most effect via impact on the funding ratio.

Conclusion

- Pension pot division method leads to cut in pension payments as soon as the initial funding ratio is below 100%.
  - Unless these cuts - on own account - are postponed via a higher assumed interest rate.
- Pension wealth adjustments are not equal for all retirees
- Sensitivity of pension wealth adjustment depends primarily on changes in funding ratio, e.g., due to changes in unhedged interest rate risk or longevity risk.