The optimal mix of the first and second pension pillar

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Thomas Michielsen
Sander Muns

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Introduction

- Public debate in many Western countries about ‘best’ structure of old-age pensions

- Population ageing makes 1st pillar pensions more expensive
  - Strikes in Belgium, France and Greece against retirement age increases
  - Bundesbank: raise retirement age to age 69 in 2060
  - OECD Pensions Outlook: more pre-funding old-age provisions

- Low interest rate makes 2nd pillar pensions more expensive
  - lower expected returns in 2nd pillar
  - decreases funding ratios of 2nd pillar pensions immediately

- Larger 1st pillar may compensate current retirees for low interest rate
Introduction

NL pillars in an international context (left) and over time (right)
Introduction

Returns (Aaron-Samuelson rule)

1\textsuperscript{st} pillar: growth wage $sum$

2\textsuperscript{nd} pillar: return on assets

\textbf{con 1: age decomposition}

\textbf{con 2: low interest rate}

After the financial crisis, asset returns have been (temporarily?) higher by increasing bond prices and increasing stock prices due to lower interest rates and lower discount rates
Introduction

Returns (Aaron-Samuelson rule)

1st pillar: growth wage sum  
2nd pillar: return on assets

• In general: growth in wage sum < return on assets
  – potential Pareto improvement from larger 2nd pillar (Miles and Černý, 2006)
  – zero-sum in present value of public tax income (Sinn, 2000)

• General equilibrium effect with larger 1st pillar (closed economy):  
  less savings → lower capital stock → lower wages (Kitao, 2014)

• This is about expected returns, our paper takes uncertainty into account
This paper

• Simulation study of pension outcomes with different mixes of 1st and 2nd pillar

• 2000 simulations using an Asset Liability Management model

• Scenarios vary in demographic as well as financial variables

• Evaluation based on CRRA utility and distribution of replacement rates

• Impulse response analysis evaluates impact of shocks in mortality and equity premium
Main results

• Compared to 1st pillar, 2nd pillar has a higher but less certain return

• Young and future generations prefer a mix of both pillars

• Preferences of cohorts born before 1970s depend on initialization:
  – first pillar-only if initial rights are always based on 50-50 mix
  – second pillar-only if initial rights are adjusted to each mix

• Different shocks have a different speed of impact:

<table>
<thead>
<tr>
<th>Type of shock</th>
<th>1st pillar</th>
<th>2nd pillar</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mortality</td>
<td>Slow</td>
<td>Immediate</td>
</tr>
<tr>
<td>Equity premium</td>
<td>No</td>
<td>Slow</td>
</tr>
</tbody>
</table>
Literature: Risk sharing in the two pillars

- 1\textsuperscript{st} pillar and DB 2\textsuperscript{nd} pillar (Beetsma and Bovenberg, 2009; Beetsma, Romp and Vos, 2013)
  - old share in wage risk of the young
  - insulates the old from volatile financial markets

- Diversification benefits between 1\textsuperscript{st} (demographic) and 2\textsuperscript{nd} pillar (financial) risks (Matsen and Thøgersen, 2004)
Literature: Welfare gains from intergenerational risk sharing in second pillar

- In 2nd pillar, individuals can be exposed to financial market risk before they are ‘born’/enter the labor market (Teulings and de Vries, 2006; Bovenberg et al, 2007; Gollier, 2008; Cui, de Jong and Ponds, 2011; Mehlkopf, 2011)

- The longer investment horizon enables a better risk/return tradeoff

- Welfare benefits range from zero to 25%, depends on labour market response, equity premium, risk aversion, etc.
Assumptions

• Regardless of mix, same total contribution rate (17¼% of wage)

• Representative individual per birth cohort:
  starts to work full-time at age 25, maximum age 120

• Retirement age fixed at 70, independent of life expectancy

• No cross-sectional difference in wages:
  – in each year, all workers earn same wage, regardless of age
  – real wages do grow over time

• CRRA utility function ($\beta = 0.98, r_t =$ replacement rate periode $t$)

$$U(r; \beta, \gamma) = \sum_{t=0}^{\infty} P[\text{alive and pensioned in year } t] \beta^t \frac{r_t^{1-\gamma} - 1}{1-\gamma}$$
Assumptions 1st pillar

• No contribution from public finances

• Fixed contribution rate for working individuals
  → benefit per retiree inversely proportional to old-age dependency ratio
Assumptions 2\textsuperscript{nd} pillar

\begin{itemize}
  \item Collective defined contribution (CDC)
  \item Yearly rights adjustment 1/10\textsuperscript{th} of [nominal funding ratio \textendash{} 100%]
  \item Asset mix: 50\% equities and 50\% matching bonds
  \item Risk sharing with future generations
  \item Actuarially fair rights accrual (cohort life expectancy)
  \item Asset management costs 0.5\%/yr
\end{itemize}
Limitations

- **No analysis of intragenerational redistributions**
  Larger 1st pillar makes a flexible pension age more attractive for low incomes (*flexibilisering AOW-leeftijd*).

- **Limited analysis transition effects**
  In practice, more straightforward from 2nd to 1st pillar than vice versa

- **No long-term correlation demography and financial markets**
  May weaken diversification benefits if aging → low interest rate

- **No migration**

- **No general equilibrium effects**

- **To do**
  - coupling pension age on life expectancy
  - impact of a fertility shock
Scenario set demography

Scenario set (left) and forecast Statistics Netherlands (right)

period life expectancy (yrs)

old-age dependency ratio
## Scenario set financial descriptives – base set

<table>
<thead>
<tr>
<th>Correlation table arithmetic returns</th>
<th>1 year riskfree rate</th>
<th>5 year riskfree rate</th>
<th>5 year bond return</th>
<th>Stock return</th>
<th>Inflation</th>
<th>Wage inflation</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 year riskfree rate</td>
<td>1</td>
<td>0.98</td>
<td>0.26</td>
<td>0.21</td>
<td>0.89</td>
<td>0.76</td>
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<td>5 year riskfree rate</td>
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<td>0.32</td>
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<td>0.37</td>
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<th></th>
<th>Mean return (%)</th>
<th>Standard deviation (%)</th>
<th>min (%)</th>
<th>max (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 year riskfree rate</td>
<td>2.74</td>
<td>3.15</td>
<td>-7.81</td>
<td>13.29</td>
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<tr>
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<td>-15.48</td>
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<td>7.17</td>
<td>17.94</td>
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<tr>
<td>Inflation</td>
<td>2.03</td>
<td>1.65</td>
<td>-3.09</td>
<td>7.39</td>
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<tr>
<td>Wage inflation</td>
<td>3.31</td>
<td>2.16</td>
<td>-3.78</td>
<td>11.42</td>
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<td>2.5</td>
<td>3.1</td>
<td>-7.3</td>
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<td></td>
<td>3.0</td>
<td>2.8</td>
<td>-6.0</td>
<td>11.4</td>
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<td></td>
<td>3.6</td>
<td>5.6</td>
<td>-14.8</td>
<td>22.0</td>
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<td>5.5</td>
<td>16.4</td>
<td>-47.1</td>
<td>58.1</td>
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<td></td>
<td>2.0</td>
<td>1.6</td>
<td>-2.7</td>
<td>6.7</td>
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<td>3.3</td>
<td>2.1</td>
<td>-5.2</td>
<td>9.0</td>
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Aaron-Samuelson rule on replacement rates

• Wage growth **3.3%/yr**
  Dependency ratio 0.4 in 2040 and 0.55 in 2115
  Long-run increase: \( \frac{0.55 - 0.4}{0.4} \)^{\frac{1}{75}} = 0.4%/yr
  \( 1\textsuperscript{st} \text{ pillar } \text{‘real’ return: } 3.3\% - 0.4\% - 3.3\% = -0.4\%/yr \)

• Stock return **5.5%/yr**, bond return **3.6%/yr**
  Asset management cost **0.5%/yr**
  Median pension period from 11 yrs in 2015 to 23 yrs in 2115
  Long-run increase payout period: \( (23/11)^{0.01} - 1 = 0.74\%/yr \)
  Long-run increase investment period: \( (23-11)/100 = 0.12 \text{ yrs/yr} \)
  gives increase on investments:
  \( (1 + \frac{1}{2}(5.5\% + 3.6\%) - 0.5\%)^{0.12} - 1 = 0.5\%/yr \)

  \( 2\textsuperscript{nd} \text{ pillar } \text{‘real’ return: } \frac{1}{2}(5.5\% + 3.6\%) - 0.5\% - 0.74\% + 0.5\% - 3.3\% = +0.5\%/yr \)
Preferred mix

preferred mix, historic accruals based on specific mix, base set

cohort birth year

0 1 2 3 4 5 6 7 8 9 10

0-100 25-75 50-50 75-25 100-0

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Bandwidth replacement rate

![Graph showing bandwidth replacement rate over cohort years of birth.]
## Replacement rate

<table>
<thead>
<tr>
<th>Birth cohort 1942</th>
<th>100-0</th>
<th>75-25</th>
<th>50-50</th>
<th>25-75</th>
<th>0-100</th>
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<tbody>
<tr>
<td>Median</td>
<td>61.4%</td>
<td>60.2%</td>
<td>62.4%</td>
<td>65.6%</td>
<td>69.3%</td>
</tr>
<tr>
<td>P5</td>
<td>59.9%</td>
<td>57.5%</td>
<td>56.8%</td>
<td>56.7%</td>
<td>56.9%</td>
</tr>
<tr>
<td>P1</td>
<td>59.4%</td>
<td>56.6%</td>
<td>54.9%</td>
<td>54.1%</td>
<td>53.5%</td>
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<table>
<thead>
<tr>
<th>Birth cohort 1992</th>
<th>100-0</th>
<th>75-25</th>
<th>50-50</th>
<th>25-75</th>
<th>0-100</th>
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<tbody>
<tr>
<td>Median</td>
<td>41.3%</td>
<td>53.1%</td>
<td>65.3%</td>
<td>75.5%</td>
<td>84.7%</td>
</tr>
<tr>
<td>P5</td>
<td>35.4%</td>
<td>38.3%</td>
<td>39.5%</td>
<td>40.0%</td>
<td>39.7%</td>
</tr>
<tr>
<td>P1</td>
<td>33.1%</td>
<td>35.0%</td>
<td>34.5%</td>
<td>32.8%</td>
<td>30.9%</td>
</tr>
</tbody>
</table>
Preferred mix

preferred mix, historic accruals based on 50-50, base set
Impulse response mortality rates

relative change mortality rate

-80%  -40%  0%  40%  80%  120%

2015  2020  2025  2030  2035  2040  2045  2050  2055  2060

Lower bound 95% interval
Lower bound 67% interval
Upper bound 67% interval
Upper bound 95% interval
Bandwidth replacement rate mortality shock

![Graph showing bandwidth replacement rate mortality shock](image)

Key:
- **100-0 P50**
- **100-0 P5**
- **100-0 P95**
- **100-0 M shock P50**
- **100-0 M shock P5**
- **100-0 M shock P95**
- **0-100 P50**
- **0-100 P5**
- **0-100 P95**
- **0-100 M shock P50**
- **0-100 M shock P5**
- **0-100 M shock P95**

**Cohort year of birth**

**1950** **1960** **1970** **1980** **1990** **2000** **2010**

**25%** **50%** **100%** **200%** **400%**
Replacement rates – mortality shock

<table>
<thead>
<tr>
<th>Birth cohort</th>
<th>100-0</th>
<th>50-50</th>
<th>0-100</th>
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<tbody>
<tr>
<td></td>
<td>base M shock</td>
<td>rel. diff</td>
<td>base M shock</td>
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<tr>
<td>Median</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>1942</td>
<td>61.4% 59.0%</td>
<td>-3.9%</td>
<td>62.4% 59.3%</td>
</tr>
<tr>
<td>P5</td>
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<tr>
<td>1992</td>
<td>41.3% 32.5%</td>
<td>-21%</td>
<td>65.3% 52.0%</td>
</tr>
<tr>
<td>P5</td>
<td>35.4% 28.3%</td>
<td>-20%</td>
<td>39.5% 31.5%</td>
</tr>
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<td>P1</td>
<td>33.1% 26.6%</td>
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</table>
Bandwidth replacement rate equity premium shock

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**50-50 P50**

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**50-50 P95**

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**50-50 E shock P50**

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**50-50 E shock P95**

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**0-100 P50**

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**0-100 P95**

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**0-100 E shock P50**

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**0-100 E shock P95**
## Replacement rates – equity premium shock

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<td><strong>P1</strong></td>
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</table>
Robustness scenario set

- **base**
  - Specific mix: preferred mix, historic accruals based on specific mix, base set
  - Historic accruals: preferred mix, historic accruals based on specific mix, base set
  - 50-50 mix: preferred mix, historic accruals based on 50-50, base set

- **ZLB**
  - Specific mix: preferred mix, historic accruals based on specific mix, ZLB set
  - Historic accruals: preferred mix, historic accruals based on specific mix, ZLB set
  - 50-50 mix: preferred mix, historic accruals based on 50-50, ZLB set

- **low interest rate**
  - Specific mix: preferred mix, historic accruals based on specific mix, low interest rates set
  - Historic accruals: preferred mix, historic accruals based on specific mix, low interest rates set
  - 50-50 mix: preferred mix, historic accruals based on 50-50, low interest rates set

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Transition towards first pillar

- Assume historic contribution rate to both pillars is 50%

- From the first simulation year onwards, the contribution rate to the 1\textsuperscript{st} pillar is 60% and to the 2\textsuperscript{nd} pillar 40%

- Current pensioners benefit directly

- Future loss of 2\textsuperscript{nd} pillar pension dominates for generations born in 1975 and later
Conclusions

• Generational gap
  – Young generations prefer a mix of both pillars
  – Preferences of older generations depend on initialization

• Permanent mortality shock
  – immediate impact on 2\textsuperscript{nd} pillar benefits through the funding ratio
  – slower impact on 1\textsuperscript{st} pillar benefits

• Permanent equity premium shock
  – small impact on 2\textsuperscript{nd} pillar benefits in the short run
  – stronger impact in the longer run

• Results are qualitatively the same with scenario sets with a zero lower bound or with permanently low interest rates
Policy implications

• Current Dutch policy mix is about 50-50

• A larger 1st pillar at the expense of the 2nd pillar would result in
  – lower median replacement rate: coming increase in the dependency ratio dominates the effect of lower interest rates
  – a redistribution between generations where only older cohorts are still better off in case asset returns are low

• A redistribution within cohorts is not evaluated, 1st pillar guarantees minimum of existence

• Current Dutch policy for 1st pillar pension as a minimum of existence seems very reasonable