Kent Academic Repository

Full text document (pdf)

Citation for published version


DOI

Link to record in KAR

http://kar.kent.ac.uk/57283/

Document Version

UNSPECIFIED

Copyright & reuse

Content in the Kent Academic Repository is made available for research purposes. Unless otherwise stated all content is protected by copyright and in the absence of an open licence (eg Creative Commons), permissions for further reuse of content should be sought from the publisher, author or other copyright holder.

Versions of research

The version in the Kent Academic Repository may differ from the final published version. Users are advised to check http://kar.kent.ac.uk for the status of the paper. Users should always cite the published version of record.

Enquiries

For any further enquiries regarding the licence status of this document, please contact:

researchsupport@kent.ac.uk

If you believe this document infringes copyright then please contact the KAR admin team with the take-down information provided at http://kar.kent.ac.uk/contact.html
Risk assessment of UK DB pension schemes

Aniketh Pittea
Pradip Tapadar
University of Kent, Canterbury, CT2 7NF, UK

University of Waterloo, June 2016

Acknowledgement: Institute and Faculty of Actuaries, UK, has provided a grant to support our attendance at this conference
Agenda

1. Introduction
2. Economic capital
3. Stochastic model
4. Model assumptions
5. Results
6. PPF
7. Conclusions
Agenda

1. Introduction
2. Economic capital
3. Stochastic model
4. Model assumptions
5. Results
6. PPF
7. Conclusions
Background

Regulatory developments

- Basel 2/3.
- Solvency 2.
- Pensions Regulations.

Pensions: Developments in the UK

- Private pension membership: 46% (1997) to 32% (2012).
- DB scheme membership: 34% (1997) to 8% (2012).

Questions:

1. Impact of capital requirements on individual DB pension schemes.
2. Role of the PPF for the risk management of the entire sector.
Agenda

1. Introduction
2. Economic capital
3. Stochastic model
4. Model assumptions
5. Results
6. PPF
7. Conclusions
**Economic capital** is the excess of assets over liabilities in respect of accrued benefits required to ensure that assets exceed liabilities on all future valuation dates over a specified time horizon with a prescribed high probability.

**Notations:**

- $X_t$: Net cash flow of the scheme;
- $L_t$: Value of s179 liability of the scheme;
- $I_{s,t}$: Accumulation factor;
- $D_{s,t}$: Discount factor.

**Building blocks**

- $P_t = L_{t-1}I_{(t-1,t)} - X_t - L_t$: Profit vector, with $P_0 = -X_0 - L_0$.
- $R_t = \sum_{s=0}^t P_s I_{s,t}$: Accumulated retained profits until time $t$,
- $V_t = \sum_{s=t+1}^T P_s D_{s,t}$: Present value of future profits at time $t$. 
Eligible Scheme Cashflow and Capital Requirement

Capital requirement: \( C_t = \max \left[ -\min_{s=t}^{T} V_s D_{t,s}, 0 \right] \).

Economic capital requirement: \( \rho(C_t) = \text{VaR}(C_t, p = 0.995) \).
Agenda

1. Introduction
2. Economic capital
3. Stochastic model
4. Model assumptions
5. Results
6. PPF
7. Conclusions
The individual economic random variables, $Z_{it}$s, are modelled as:

$$Z_{it} = \mu_i + Y_{it}, \text{ where } Y_{it} = \beta_i Y_{i(t-1)} + \varepsilon_{it} \text{ and } \varepsilon_{it} \sim N(0, \sigma_i^2).$$

The error terms

- are assumed to be independently distributed across time $t$;
- which are directly connected to each other are dependent;
- which are indirectly connected are still dependent, but more weakly so.
The mortality model used is developed in three steps:

**Step 1:** Set S1PM and S1PF as the baseline mortality tables for males and females respectively.

**Step 2:** Project these base mortality tables from year 2006 to year 2012 using the mortality projection table published by the Institute and Faculty of Actuaries.

**Step 3:** Finally, model the future stochastic mortality improvements starting from 2012 by modelling stochastic uncertainty around the central mortality projection (Sweeting (2008)).
Agenda

1. Introduction
2. Economic capital
3. Stochastic model
4. Model assumptions
5. Results
6. PPF
7. Conclusions
## Membership Profile

**Table:** Average membership profile of eligible schemes.

<table>
<thead>
<tr>
<th>Membership group (Members)</th>
<th>Number of schemes</th>
<th>Average membership</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Active</td>
</tr>
<tr>
<td>A: (5-99)</td>
<td>2,260</td>
<td>6 (13%)</td>
</tr>
<tr>
<td>B: (100-999)</td>
<td>2,828</td>
<td>56 (16%)</td>
</tr>
<tr>
<td>C: (1,000-4,999)</td>
<td>824</td>
<td>384 (17%)</td>
</tr>
<tr>
<td>D: (5,000-9,999)</td>
<td>192</td>
<td>1,231 (17%)</td>
</tr>
<tr>
<td>E: (Over 10,000)</td>
<td>212</td>
<td>6,651 (19%)</td>
</tr>
</tbody>
</table>
## Model Points

### Table: Eligible schemes model points.

<table>
<thead>
<tr>
<th>Membership types</th>
<th>Age</th>
<th>Gender</th>
<th>Accrued service/benefit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Active</td>
<td>30</td>
<td>Male/Female</td>
<td>7 years past service</td>
</tr>
<tr>
<td></td>
<td>40</td>
<td>Male/Female</td>
<td>16 years past service</td>
</tr>
<tr>
<td></td>
<td>50</td>
<td>Male/Female</td>
<td>25 years past service</td>
</tr>
<tr>
<td></td>
<td>60</td>
<td>Male/Female</td>
<td>34 years past service</td>
</tr>
<tr>
<td>Deferred</td>
<td>50</td>
<td>Male</td>
<td>Accrued pension of £3,000 per year</td>
</tr>
<tr>
<td></td>
<td>50</td>
<td>Female</td>
<td>Accrued pension of £1,500 per year</td>
</tr>
<tr>
<td>Pensioner</td>
<td>70</td>
<td>Male</td>
<td>Pension of £6,000 per year</td>
</tr>
<tr>
<td></td>
<td>70</td>
<td>Female</td>
<td>Pension of £3,000 per year</td>
</tr>
</tbody>
</table>
Assets, Liabilities and Investment Strategies

Table: Comparison of assets and liabilities.

<table>
<thead>
<tr>
<th></th>
<th>Estimated</th>
<th>Actual</th>
</tr>
</thead>
<tbody>
<tr>
<td>Assets</td>
<td>£1,018b</td>
<td>£1,027b</td>
</tr>
<tr>
<td>Liabilities</td>
<td>£1,218b</td>
<td>£1,231b</td>
</tr>
</tbody>
</table>

Table: Distribution of eligible scheme by investment strategies.

<table>
<thead>
<tr>
<th>Investment strategy</th>
<th>Asset allocation</th>
<th>Proportion of eligible schemes</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Equities</td>
<td>Bonds</td>
</tr>
<tr>
<td>L</td>
<td>25%</td>
<td>75%</td>
</tr>
<tr>
<td>M</td>
<td>50%</td>
<td>50%</td>
</tr>
<tr>
<td>H</td>
<td>75%</td>
<td>25%</td>
</tr>
</tbody>
</table>

PPF broadly follows investment strategy L.
Agenda

1. Introduction
2. Economic capital
3. Stochastic model
4. Model assumptions
5. Results
6. PPF
7. Conclusions
Aggregate Economic Capital for Eligible Schemes

As at 31 March 2012

Economic capital (£ billion)

0 500 1000 1500 2000 2500

Assets
£ 1,018 billion

Liabilities
£ 1,218 billion

Economic Capital
£ 1,231 billion
Results

Economic Capital: Eligible Scheme in A

Membership group A

Liability and economic capital (£ million)

2020 2040 2060 2080 2100

$\rho_t^{AH}$ $\rho_t^{AM}$ $\rho_t^{AL}$ $L_t^A$

Risk assessment of UK DB pension schemes

University of Waterloo, June 2016
Eligible Schemes: Liability Comparison

\[ \frac{L_t^X}{L_0^X} \text{ as multiples of } \frac{L_t^A}{L_0^A} \text{ where } X=A,B,C,D,E \]

Graph showing the comparison of liabilities for different schemes over years 2020 to 2100.
Eligible Schemes: Economic Capital Comparison

\[ \rho_{t}^{XY}/L_{0}^{X} \text{ as multiples of } \rho_{t}^{AY}/L_{0}^{A} \text{ where } X=A,B,C,D,E \text{ and } Y=L,M,H \]
Agenda

1. Introduction
2. Economic capital
3. Stochastic model
4. Model assumptions
5. Results
6. PPF
7. Conclusions
PPF Cashflow and Capital Requirement

Capital requirement: \( C_t = \max \left[ - \min_{s=t}^{T} R_{s} D_{t,s}, 0 \right] \).

Economic capital requirement: \( \rho(C_t) = \text{VaR}(C_t, p = 0.995) \).
PPF: Some Additional Assumptions

- PPF levy: 0.072% of the total s179 liabilities.
- Amortisation period: 10 years.
- Funding cap: 120% of s179 liabilities.
- Insolvency rates:

<table>
<thead>
<tr>
<th>Membership group</th>
<th>Annual insolvency rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>1.60%</td>
</tr>
<tr>
<td>B</td>
<td>0.95%</td>
</tr>
<tr>
<td>C</td>
<td>0.90%</td>
</tr>
<tr>
<td>D</td>
<td>0.53%</td>
</tr>
<tr>
<td>E</td>
<td>0.72%</td>
</tr>
</tbody>
</table>
PPF: Base Case Results

PPF schemes liability and economic capital: Base case

<table>
<thead>
<tr>
<th>Year</th>
<th>Liability (£ billion)</th>
<th>Economic capital (£ billion)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2020</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2040</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2060</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2080</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2100</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
PPF: Sensitivity Results

As at 31 March 2012

1: Base Case
2: 4-year Amortisation
3: 50% Buffer
4: (2) + (3)
PPF Takes Over All Schemes With Insolvent Sponsors

Economic capital (£ billion)

Year

PPF Takes Over All Schemes With Insolvent Sponsors

PPF takes over all schemes with insolvent sponsors

- Base
- All schemes
- + 50% buffer and 4–year amortisation
Agenda

1. Introduction
2. Economic capital
3. Stochastic model
4. Model assumptions
5. Results
6. PPF
7. Conclusions
Conclusions

Summary

- Aggregate economic capital requirement:
  - On eligible scheme basis: £1,200 billion.
  - For PPF: £35 billion.
- Reasonable capital buffer + shorter amortisation period can bring down the economic capital requirement further.

Need a holistic view, taking PPF into account, while devising regulations for defined benefit pension sector.

References