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An Economic Capital study of the Pension Protection Fund and UK's Defined Benefit Pension Sector

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Actuarial Teachers and Researchers Conference (2014) – University of Edinburgh

December 2, 2014

Agenda

- 1 Introduction
- 2 Economic capital
- 3 Stochastic model
- 4 Model assumptions
- 5 Results
- 6 Conclusions

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- 1 Introduction
 - Background
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Background

Regulatory developments

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

Pensions: Developments in the UK

- Pensions Act (2004): PPF and the Pensions Regulator.
- 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.

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- 1 Introduction
- 2 Economic capital**
 - Formulation
 - Eligible schemes
 - PPF
- 3 Stochastic model
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Economic Capital Formulation

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.

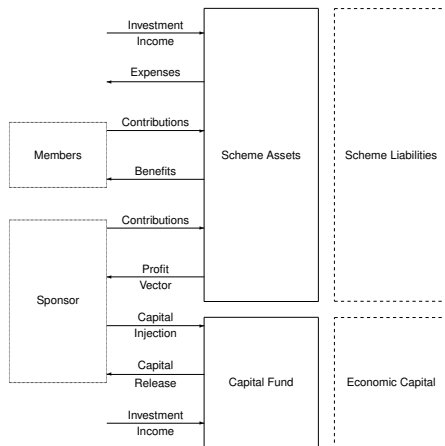
Building blocks

$P_t = L_{t-1}I_{(t-1,t)} - X_t - L_t$: 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 ,

$V_t = \sum_{s=t+1}^T P_s D_{t,s}$: Present value of future profits at time t .

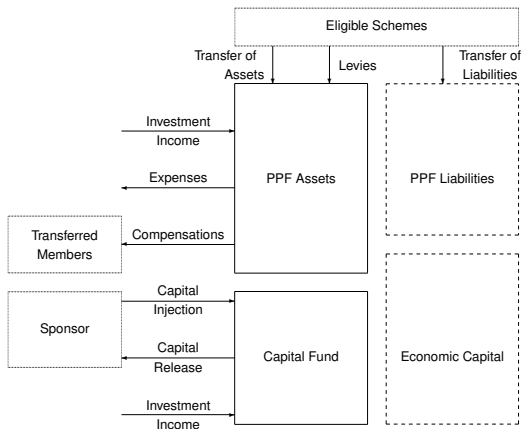
Eligible Scheme Cashflow and Capital Requirement



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

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

PPF Cashflow and Capital Requirement



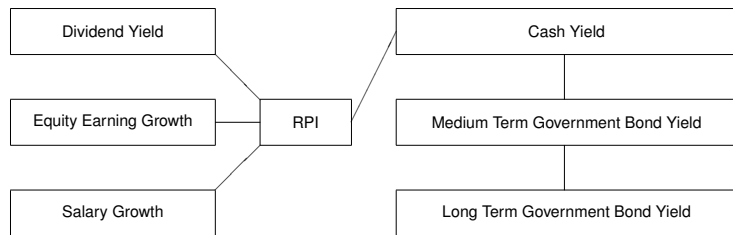
$$\text{Capital requirement: } C_t = \max \left[- \min_{s=t}^T R_s D_{t,s}, 0 \right].$$

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

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 - Economic variables
 - Longevity
- 4 Model assumptions
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Stochastic model: Economic Variables



The individual economic random variables, Z_{it} s, are modelled as:

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

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.

Stochastic model: Longevity

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)).

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 - Membership profile
 - Model points
 - Investment
- 5 Results
- 6 Conclusions

Membership Profile

Table : Average membership profile of eligible schemes.

| Membership group (Members) | Number of schemes | Average membership | | | Total |
|----------------------------|-------------------|--------------------|--------------|--------------|--------|
| | | Active | Deferred | Pensioner | |
| A: (5-99) | 2,260 | 6 (13%) | 23 (52%) | 15 (35%) | 44 |
| B: (100-999) | 2,828 | 56 (16%) | 182 (52%) | 113 (32%) | 351 |
| C: (1,000-4,999) | 824 | 384 (17%) | 1,103 (49%) | 754 (34%) | 2,241 |
| D: (5,000-9,999) | 192 | 1,231 (17%) | 3,297 (46%) | 2,601 (37%) | 7,129 |
| E: (Over 10,000) | 212 | 6,651 (19%) | 14,763 (42%) | 13,608 (39%) | 35,022 |

Model Points

Table : Eligible schemes model points.

| Membership types | Age | Gender | Accrued service/benefit |
|------------------|-----|-------------|------------------------------------|
| Active | 30 | Male/Female | 7 years past service |
| | 40 | Male/Female | 16 years past service |
| | 50 | Male/Female | 25 years past service |
| | 60 | Male/Female | 34 years past service |
| Deferred | 50 | Male | Accrued pension of £3,000 per year |
| | 50 | Female | Accrued pension of £1,500 per year |
| Pensioner | 70 | Male | Pension of £6,000 per year |
| | 70 | Female | Pension of £3,000 per year |

Assets, Liabilities and Investment Strategies

Table : Comparison of assets and liabilities.

| | Estimated | Actual |
|-------------|-----------|---------|
| Assets | £1,018b | £1,027b |
| Liabilities | £1,218b | £1,231b |

Table : Distribution of eligible scheme by investment strategies.

| Investment strategy | Asset allocation | | Proportion of eligible schemes |
|---------------------|------------------|-------|--------------------------------|
| | Equities | Bonds | |
| <i>L</i> | 25% | 75% | 25% |
| <i>M</i> | 50% | 50% | 60% |
| <i>H</i> | 75% | 25% | 15% |

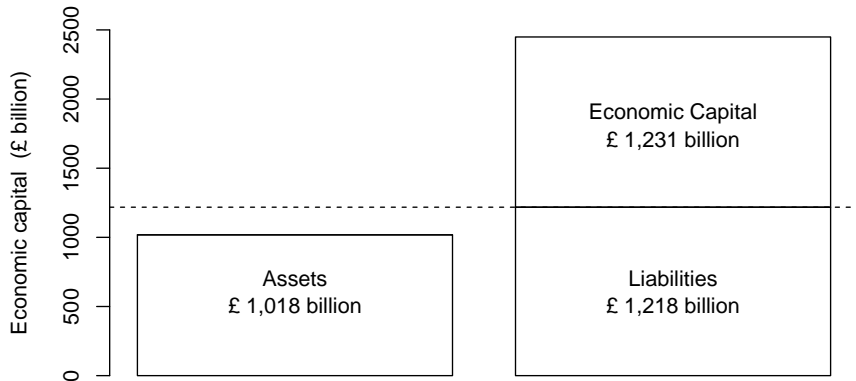
PPF broadly follows investment strategy *L*.

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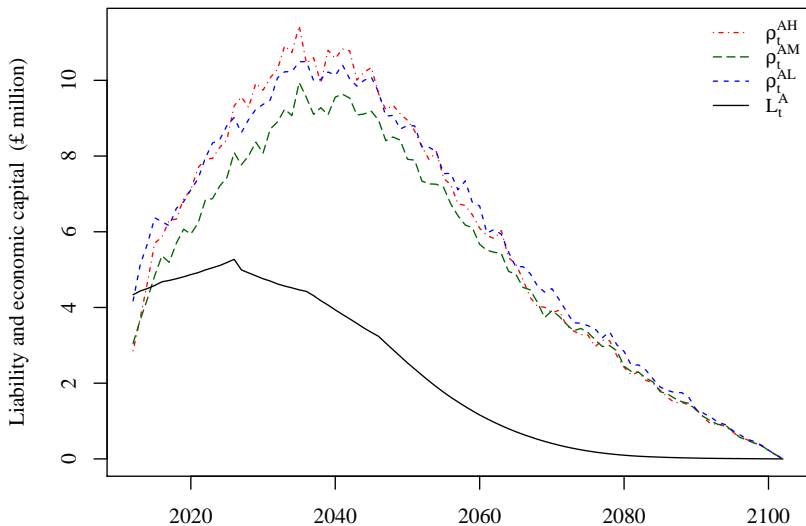
Aggregate Economic Capital for Eligible Schemes

As at 31 March 2012



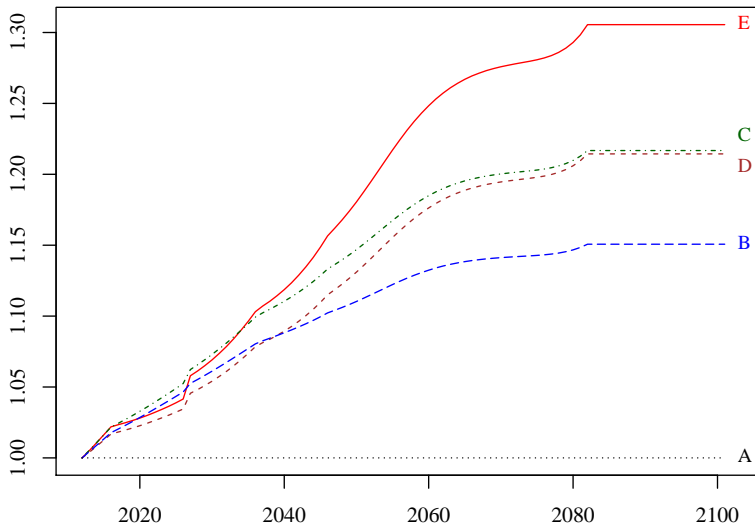
Economic Capital: Eligible Scheme in A

Membership group A



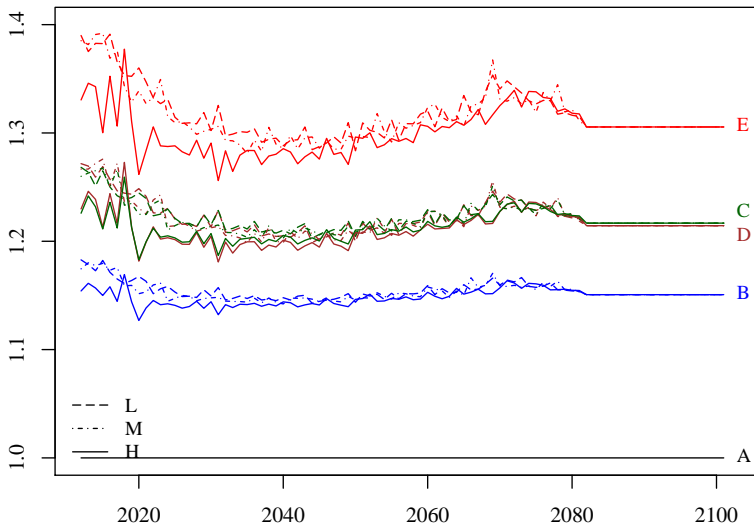
Eligible Schemes: Liability Comparison

L_t^X/L_0^X as multiples of L_t^A/L_0^A where $X=A,B,C,D,E$



Eligible Schemes: Economic Capital Comparison

ρ_t^{XY}/L_0^X as multiples of ρ_t^{AY}/L_0^A where $X=A,B,C,D,E$ and $Y=L,M,H$



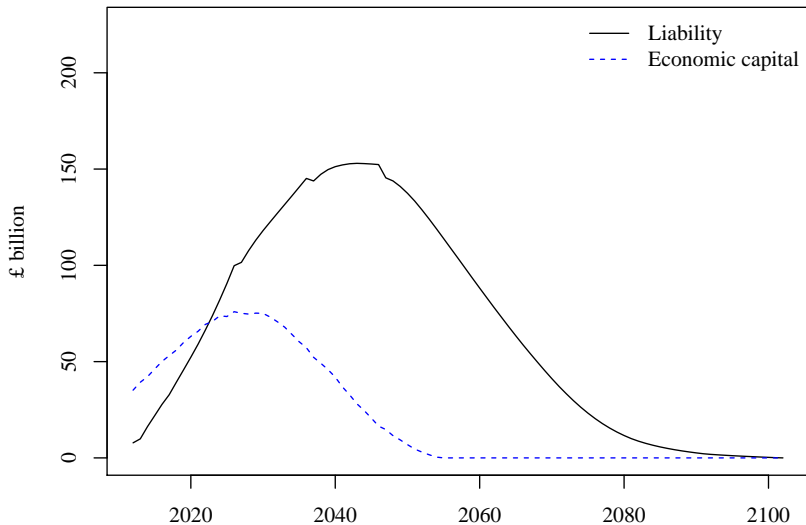
PPF: Some Additional Assumptions

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

| Membership group | Annual insolvency rate |
|------------------|------------------------|
| A | 1.60% |
| B | 0.95% |
| C | 0.90% |
| D | 0.53% |
| E | 0.72% |

PPF: Base Case Results

PPF schemes liability and economic capital : Base case



PPF: Sensitivity Results

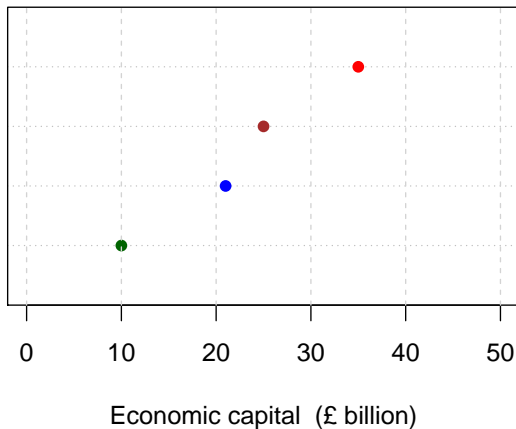
As at 31 March 2012

1: Base Case

2: 4-year Amortisation

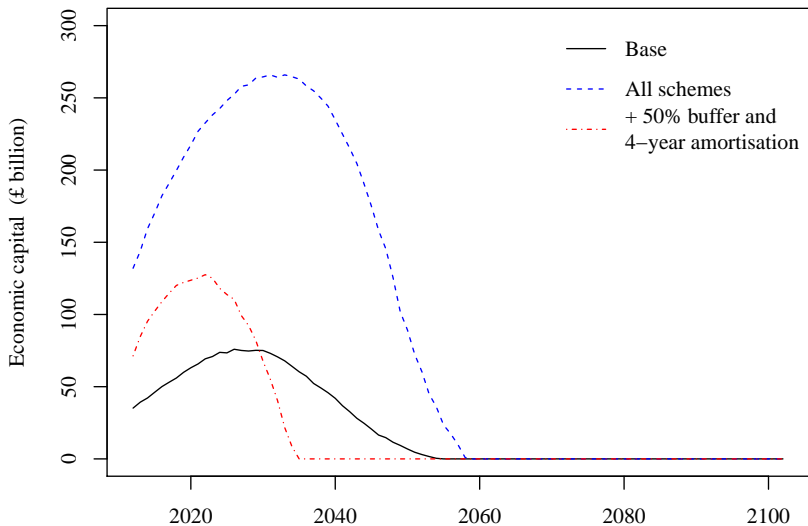
3: 50% Buffer

4: (2) + (3)



PPF Takes Over All Schemes With Insolvent Sponsors

PPF takes over all schemes with insolvent sponsors



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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

YANG, W. & TAPADAR, P. (2014). Role of the Pension Protection Fund in Financial Risk Management of UK Defined Benefit Pension Sector: A Multi-period Economic Capital Study. *To appear in Annals of Actuarial Science*.