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Risk assessment of UK DB pension schemes

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Agenda

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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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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.

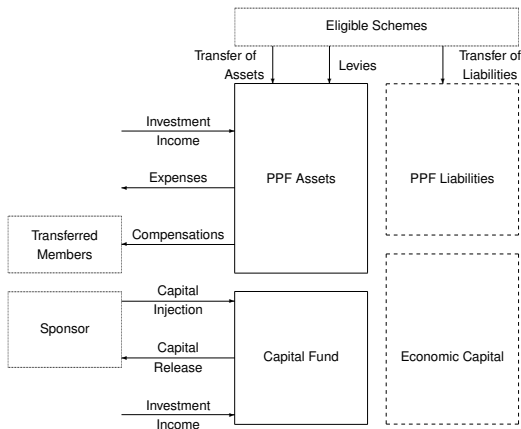# Eligible Scheme Cashflow and Capital Requirement
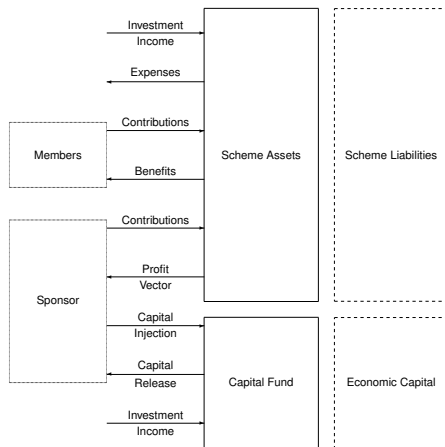
Capital requirement: $C_t = \max\left[-\min_{s=t}^{T} V_s D_{t,s}, 0\right].$

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

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: $\rho(C_t) = VaR(C_t, p = 0.995)$.

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Stochastic model: Economic Variables
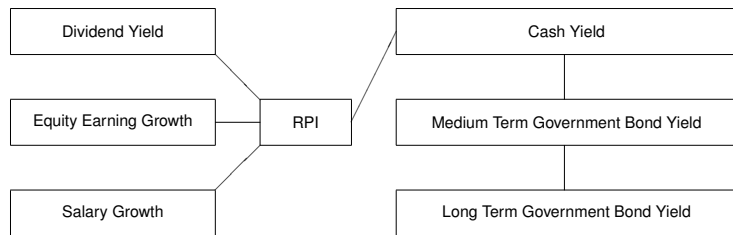
The individual economic random variables, Z_{it}s, are modelled as:

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

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.

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

Table : Average membership profile of eligible schemes.

Membership group (Members)	Number of schemes	Average membership			
		Active	Deferred	Pensioner	Total
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 Equities	Bonds	Proportion of eligible schemes
L	25%	75%	25%
M	50%	50%	60%
H	75%	25%	15%

PPF broadly follows investment strategy *L*.
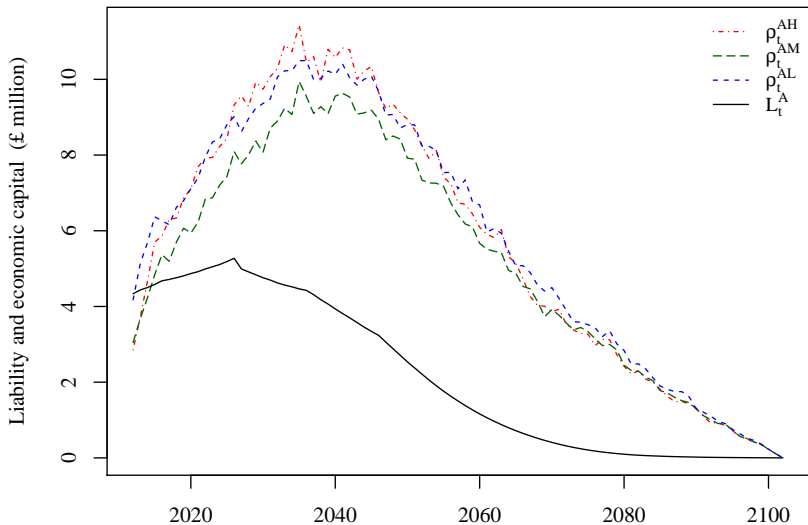
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Aggregate Economic Capital for Eligible Schemes
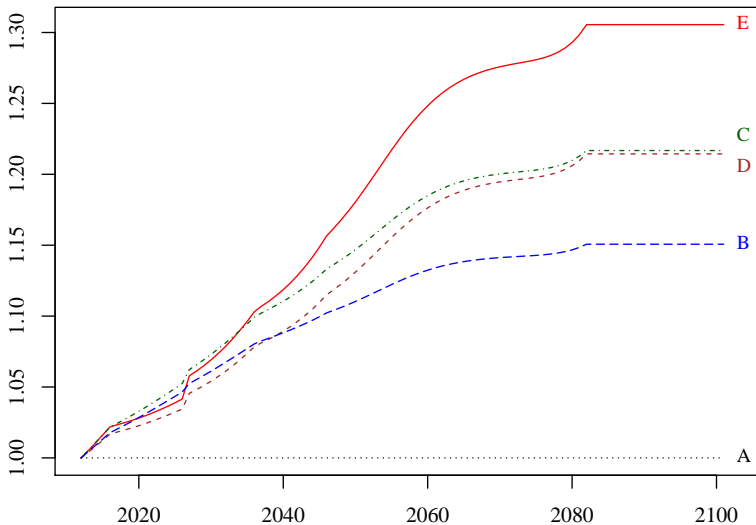

As at 31 March 2012
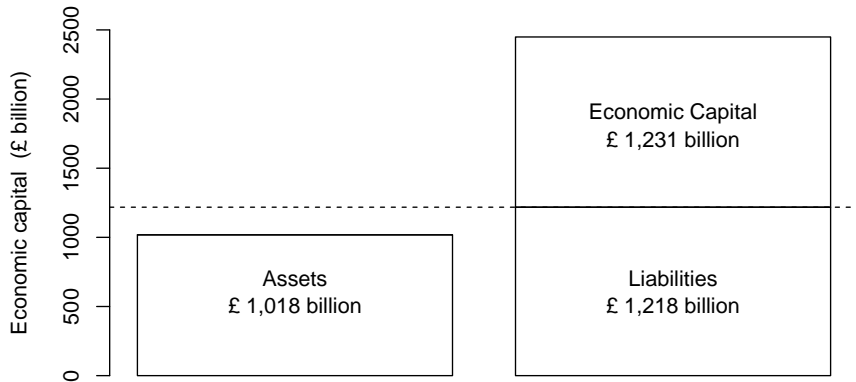
Economic Capital: Eligible Scheme in *A*
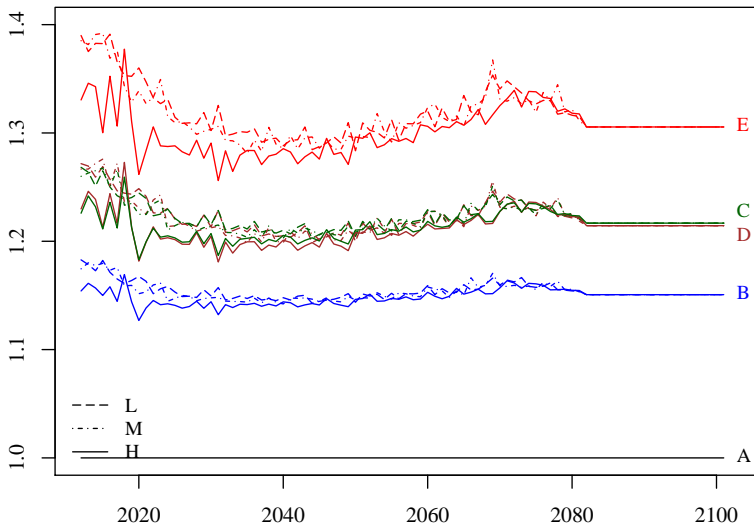

Membership group A

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
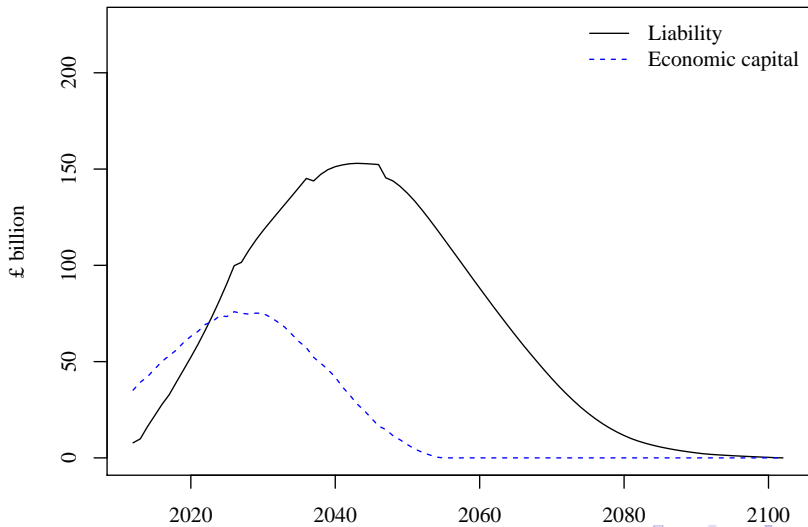
PPF: Some Additional Assumptions

- 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

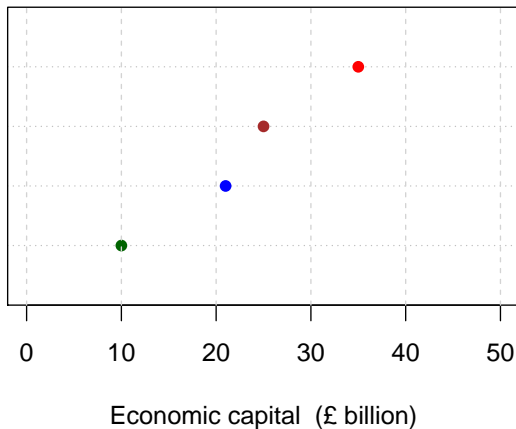PPF schemes liability and economic captial : Base case

PPF: Sensitivity Results

As at 31 March 2012

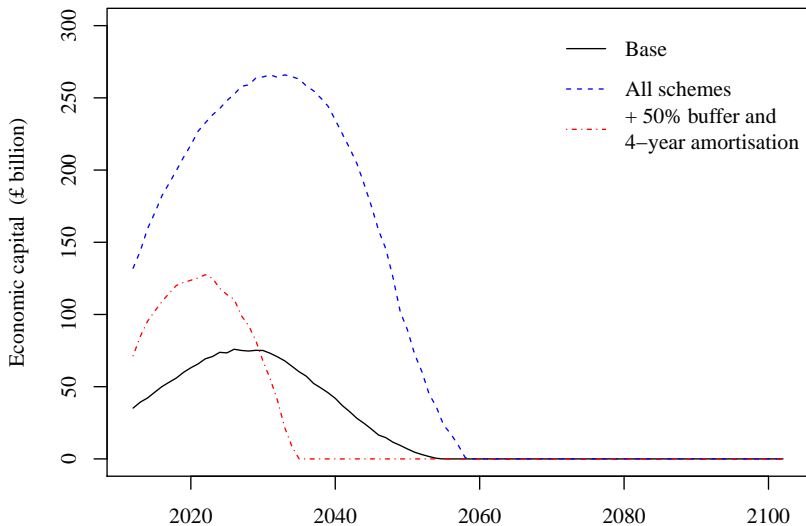1: Base Case

2: 4–year Amortisation

3: 50% Buffer

4: (2) + (3)

Economic capital (£ billion)

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. (2015). Role of the Pension Protection Fund in Financial Risk Management of UK Defined Benefit Pension Sector: A Multi-period Economic Capital Study. *Annals of Actuarial Science*, **9**, 134–166.