Role of the PPF in financial risk management of UK DB pension sector: A multi-period economic capital study

Wei Yang[1] Pradip Tapadar[2]

[1]Southwestern University of Finance and Economics, Chengdu, Sichuan, 611130, China.

[2]University of Kent, Canterbury, CT2 7NF, UK. E-mail: P.Tapadar@kent.ac.uk

IAA Colloquium, June 2015

Acknowledgement: Institute and Faculty of Actuaries, UK, has provided a grant to partially support my attendance at this colloquium.

Agenda

Agenda

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.

Agenda

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.

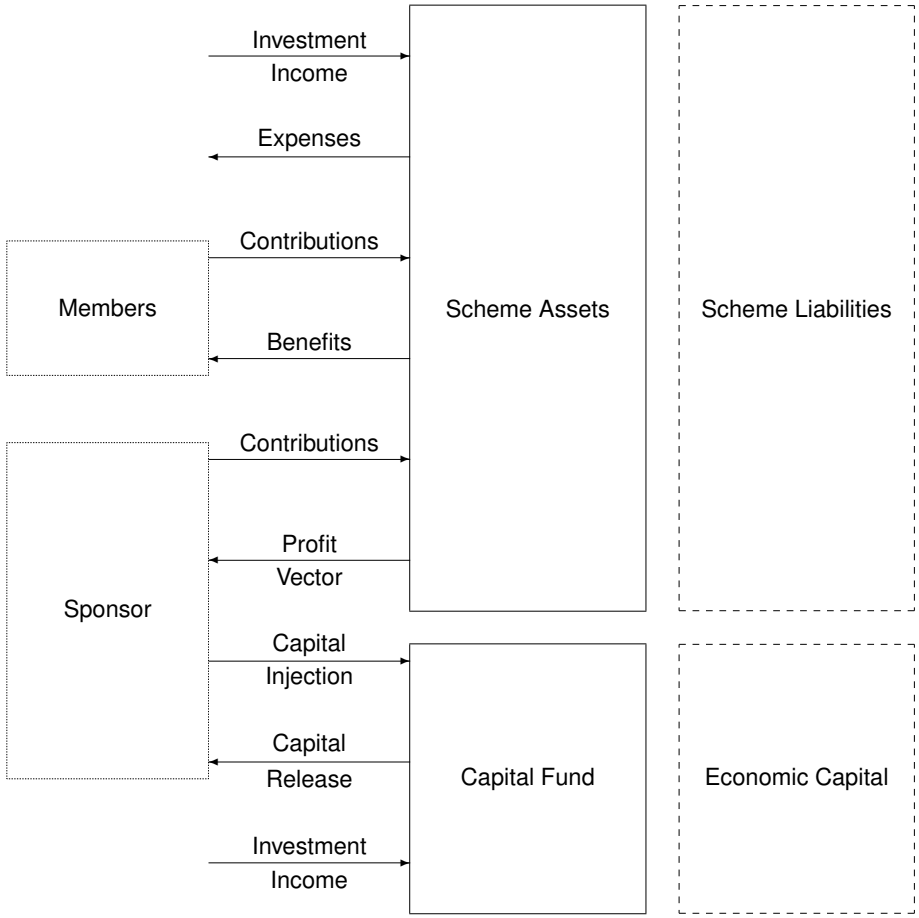
Building blocks

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

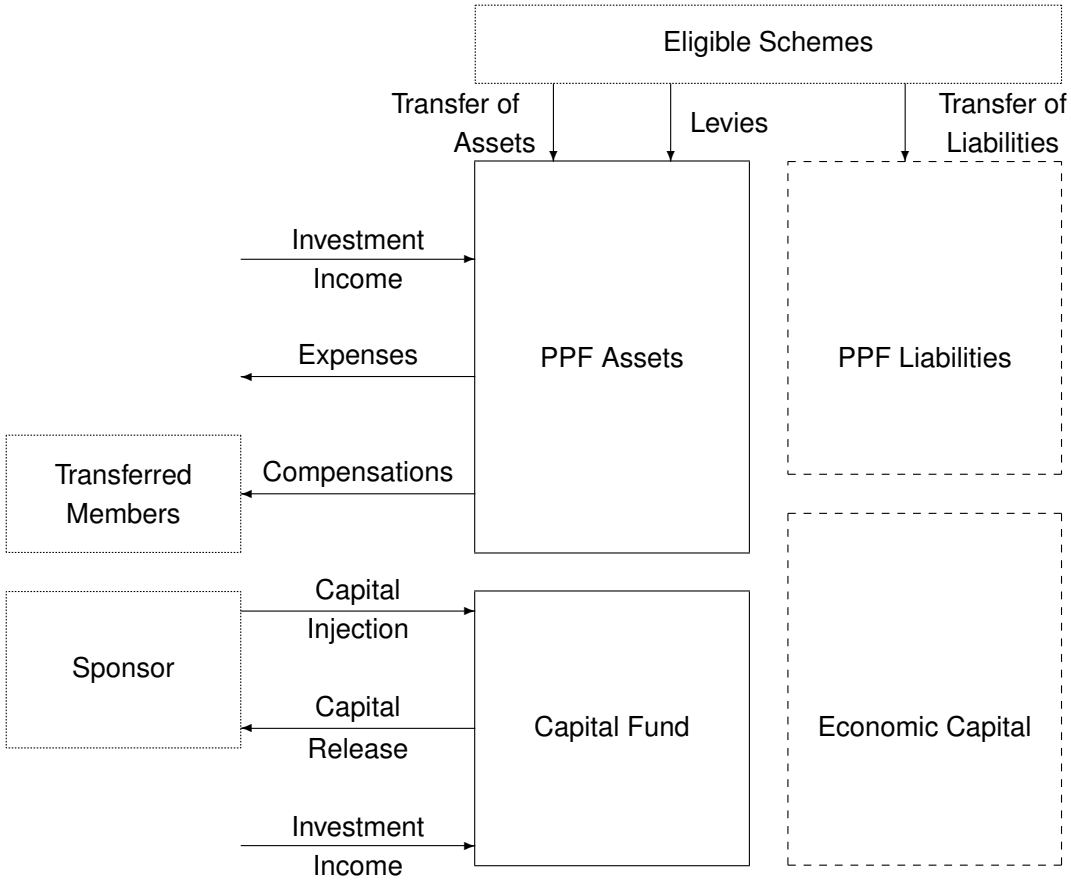
Eligible Scheme Cashflow and Capital Requirement



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

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

PPF Cashflow and Capital Requirement

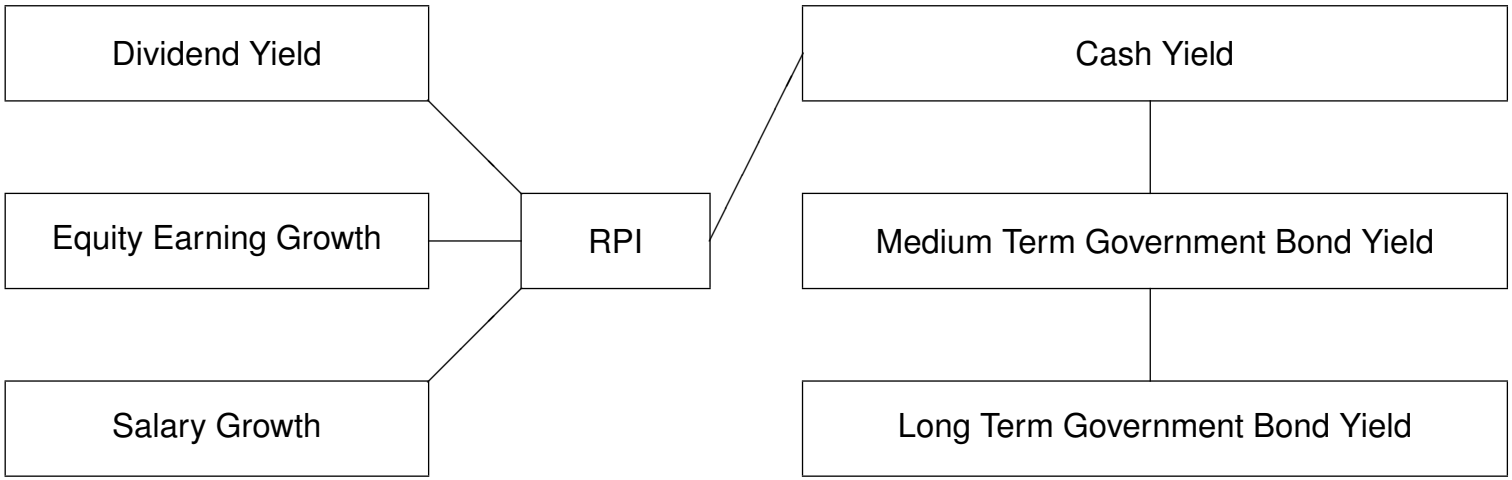


$$\text{Capital requirement: } C_t = \max\left[-\min_{s=t}^{T} R_s D_{t,s}, 0\right].$$

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

Agenda

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)).

Agenda

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

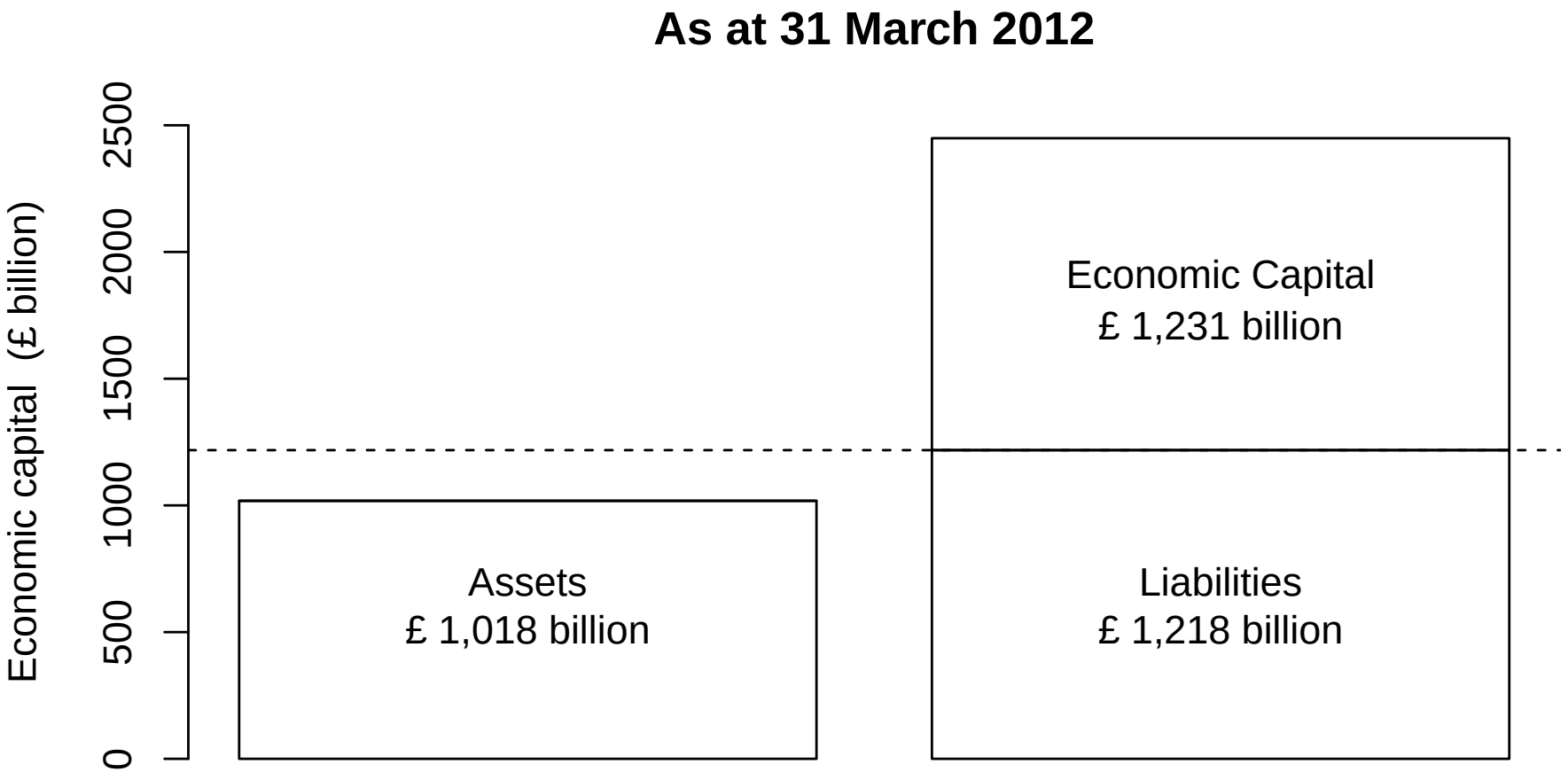
Table : Distribution of eligible scheme by investment strategies.

Investment strategy	Asset allocation Equities	Bonds	Proportion of eligible schemes
L	25%	75%	25%
M	50%	50%	60%
H	75%	25%	15%

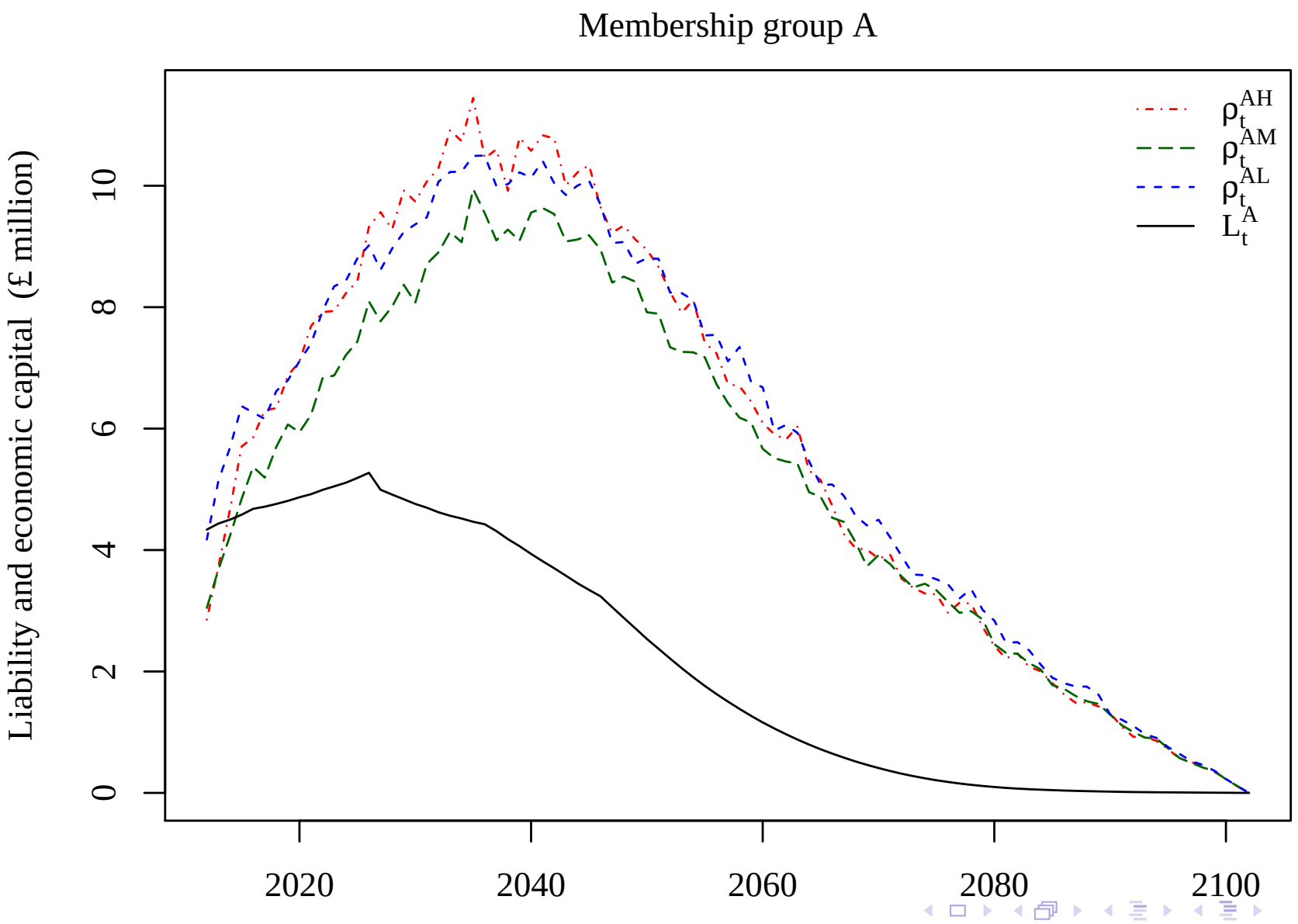
PPF broadly follows investment strategy *L*.

Agenda

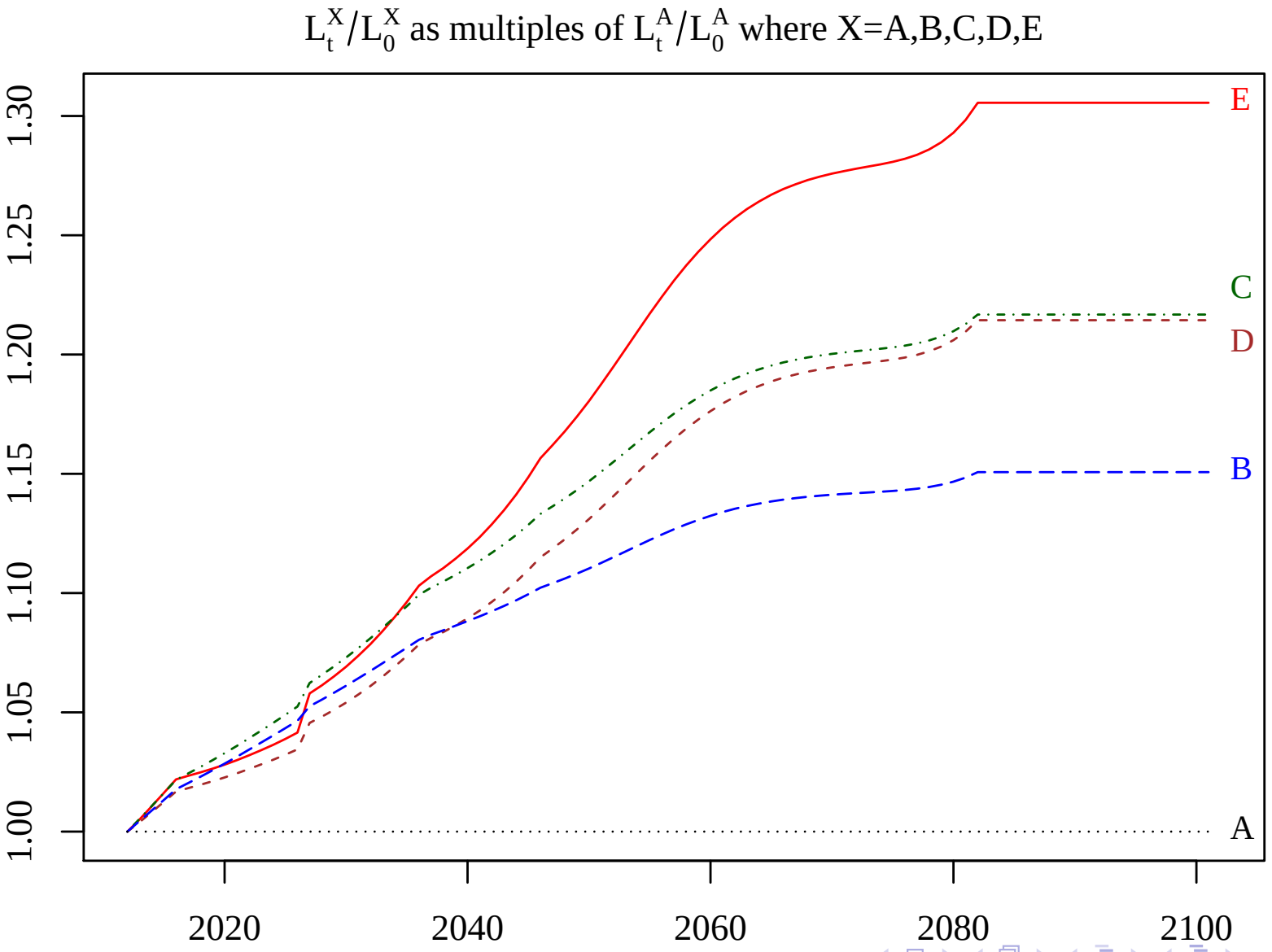
Aggregate Economic Capital for Eligible Schemes



Economic Capital: Eligible Scheme in *A*

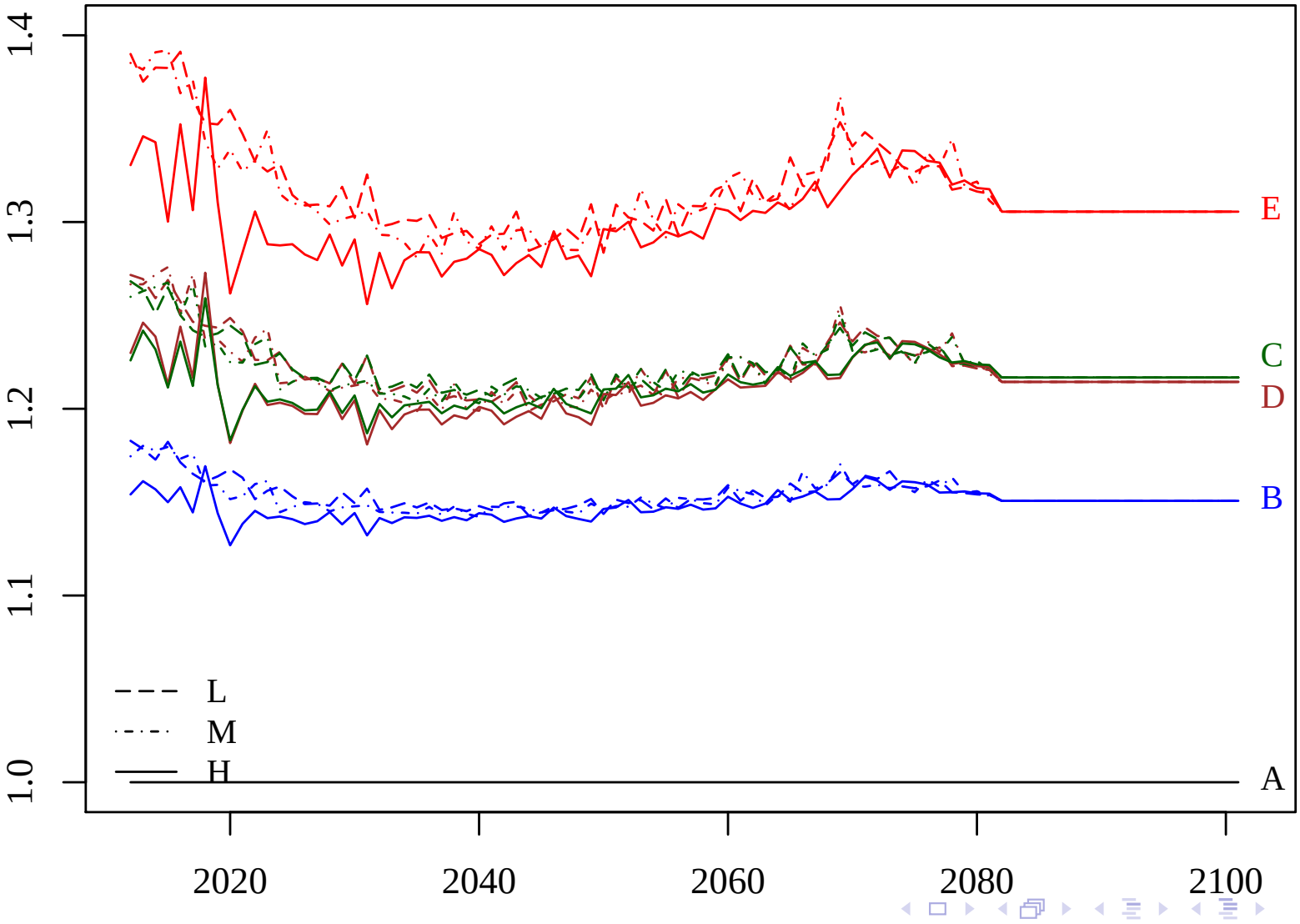


Eligible Schemes: Liability Comparison



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

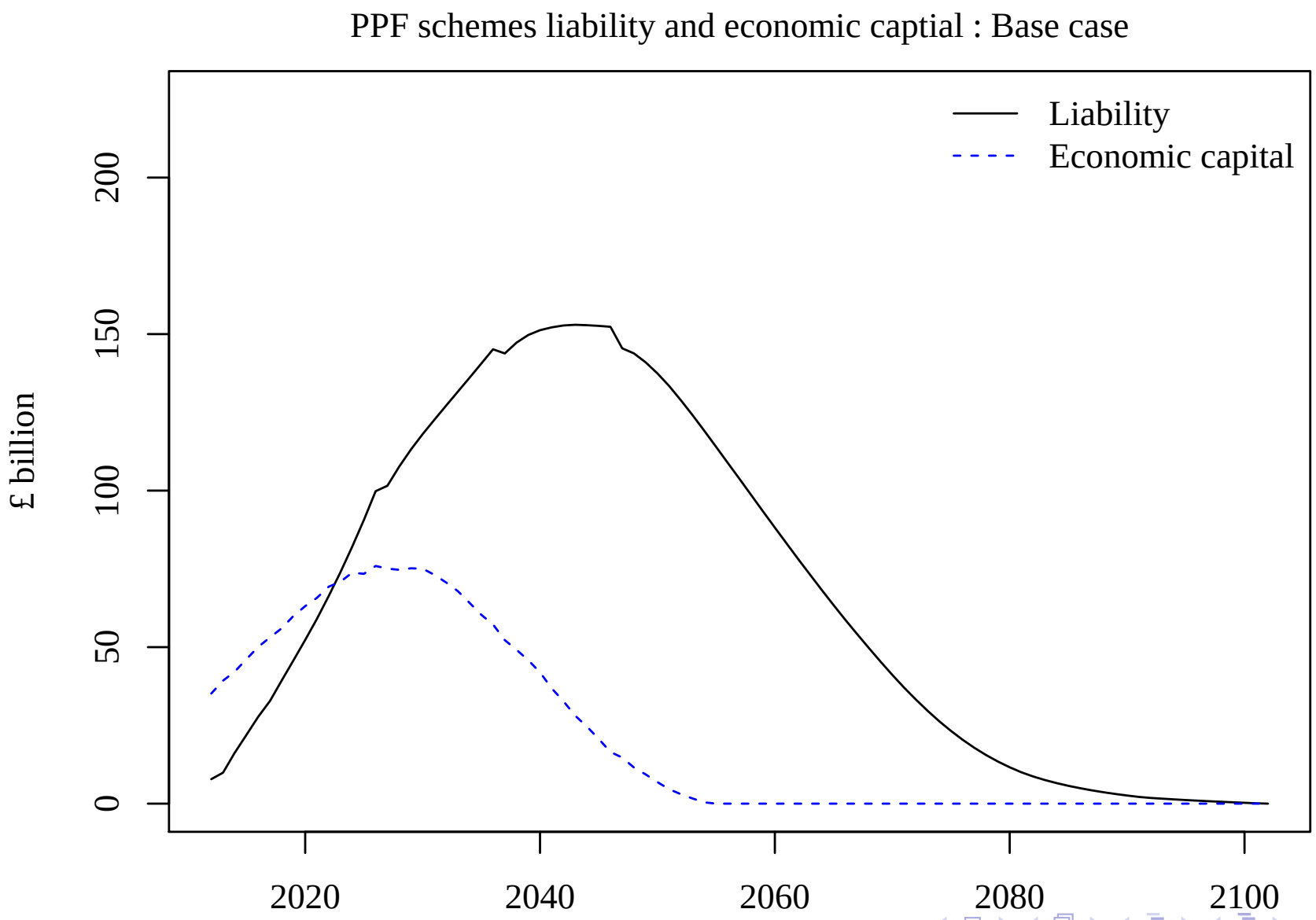


PPF: Some Additional Assumptions

- 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



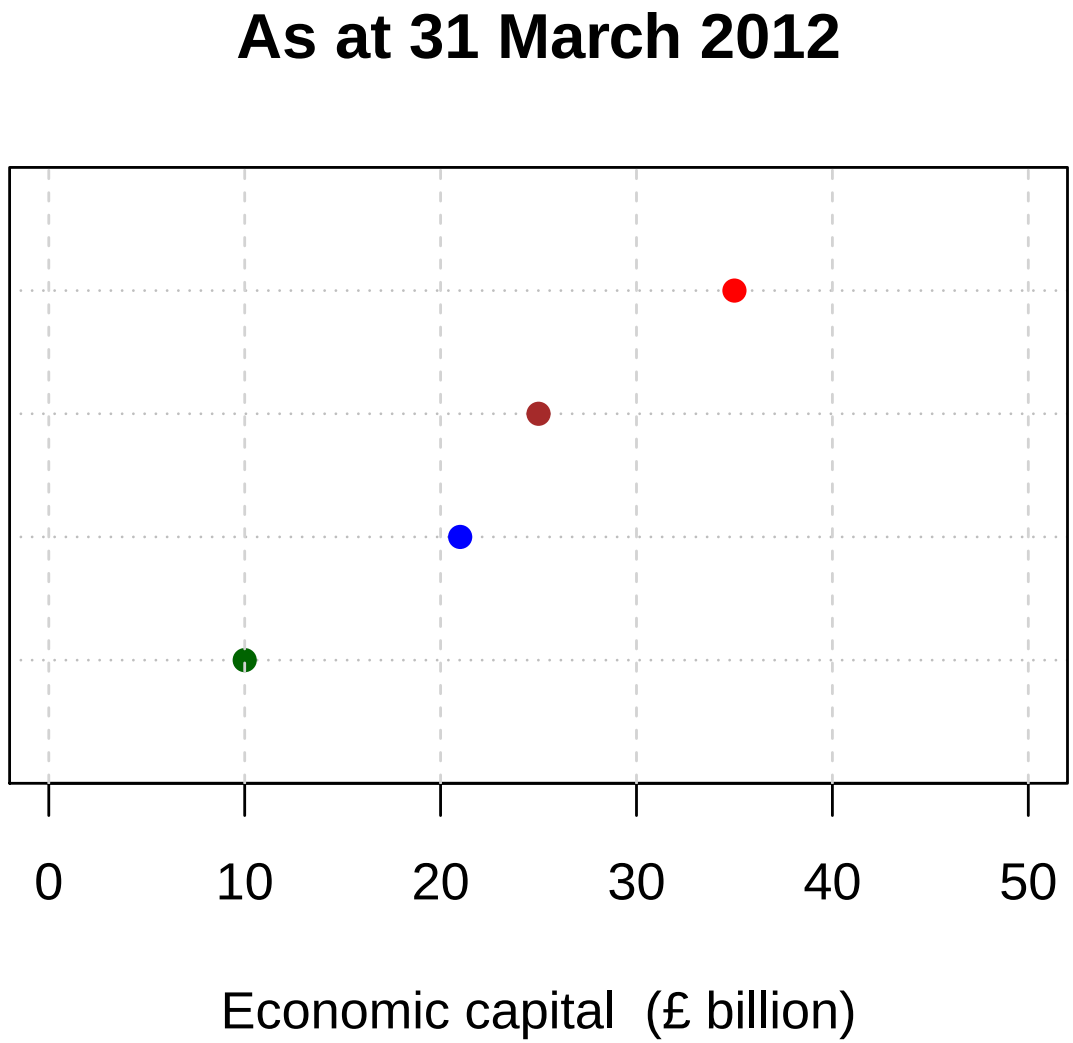
PPF: Sensitivity Results

1: Base Case

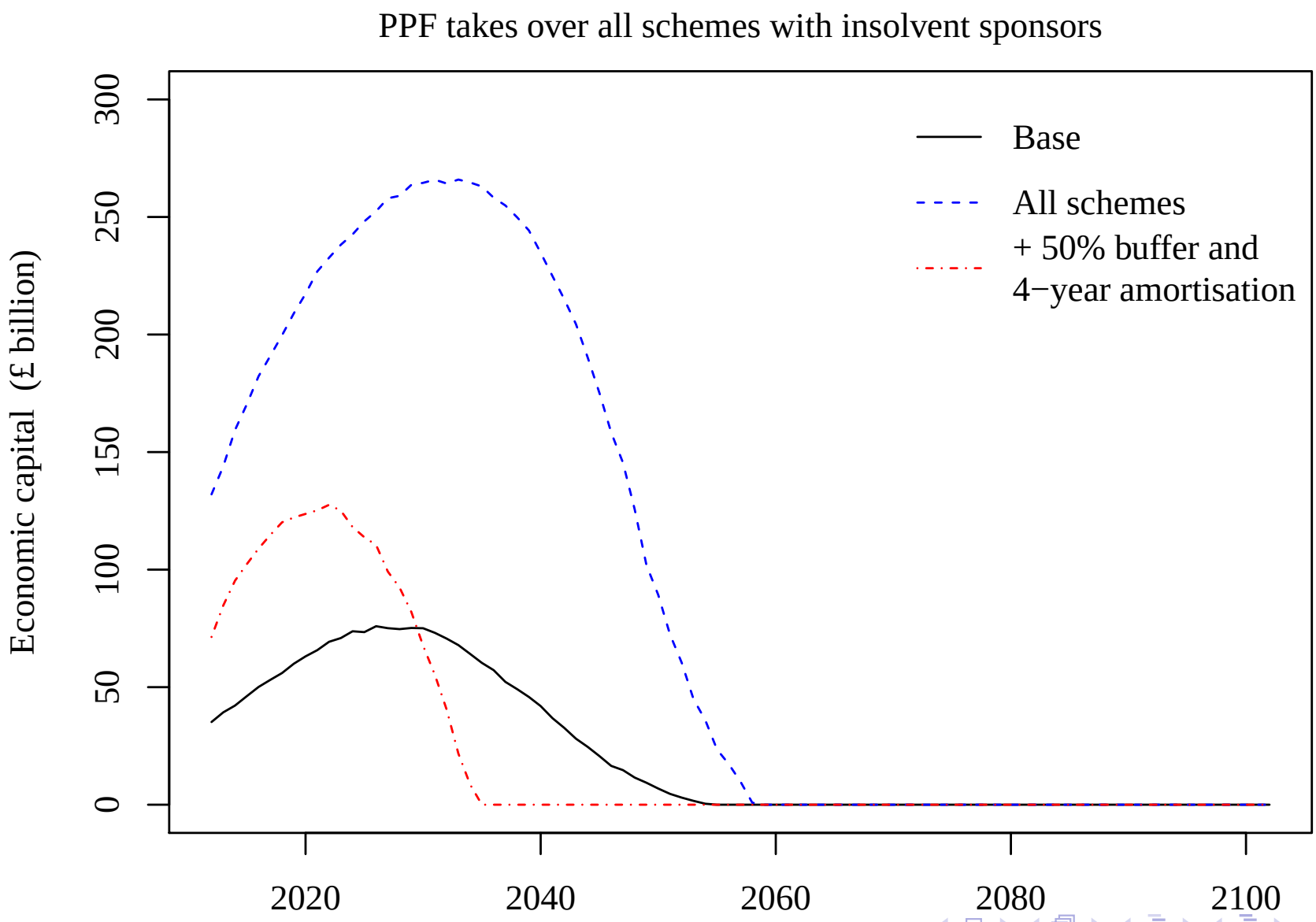
2: 4−year Amortisation

3: 50% Buffer

4: (2) + (3)



PPF Takes Over All Schemes With Insolvent Sponsors



Agenda

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.
- PORTEOUS, B.T., TAPADAR, P. & YANG, W. (2012). Economic capital for defined benefit pension schemes: An application to the UK Universities Superannuation Scheme. *Journal of Pension Economics and Finance*, **11(4)**, 471–499.
- SWEETING, P. (2008). *Stochastic Mortality Made Easy*. Staple Inn Actuarial Society.