SUPERFUNDS PROJECT

THE PENSIONS REGULATOR (TPR)

16 JUNE 2020

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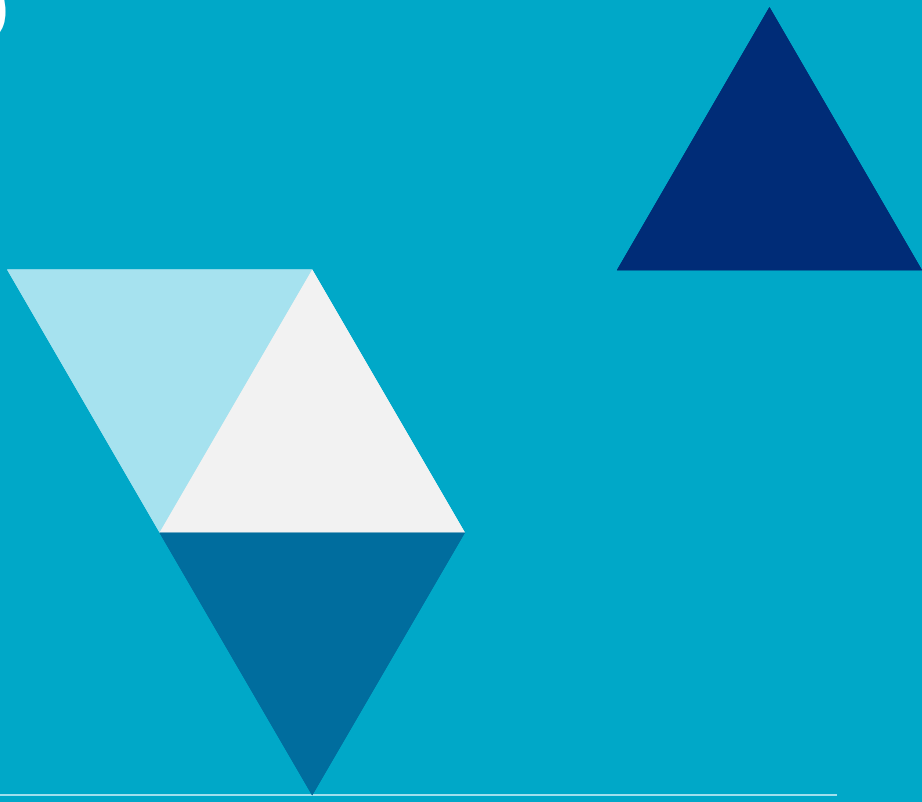
INTRODUCTION AND BACKGROUND



INTRODUCTION
OVERVIEW

- Mercer has been appointed by The Pensions Regulator ("TPR") to provide asset-liability modelling analysis and investment advice to help inform decision-making about the capital requirements for DB superfunds in the pre-authorisation phase prior to a formal regulatory framework being developed and put in place by the DWP on the capital requirements for DB superfunds.
- This paper sets out the following:
  - Estimated expected return and 1 year Value at Risk (including decomposition by risk factor) for the four investment strategies considered (Strategy A, B, C and D).
  - Projections of the funding level over a 20-year period on the funding basis for the base cashflow profile under Strategies A, B and C. Strategy D is a lower risk alternative only included in sensitivity analysis.
  - For each strategy, we consider:
    - An appropriate starting funding buffer to provide an acceptable probability of achieving full funding at the end of years 5 and 10
    - The potential for funding to fall below 100% or PPF funding to fall below 105%, as triggers for potential intervention from TPR
  - Sensitivity analysis on specific scenarios to illustrate:
    - The impact of varying interest rate hedging ratios
    - The impact of varying the maturity of the scheme
    - A strategy with lower investment risk focussed on investment grade credit (Strategy D)
  - The probability of meeting benefits, as well as considerations of when assets may run out and outstanding, unpaid benefits if that is the case.
  - The chance of reaching a proxy buyout level and the potential development of the membership profile to consider the proportion of members impacted in a "ruin event".

INTRODUCTION
OVERVIEW

- We have included the following information in the Appendix:
  - Full details of the modelling assumptions, modelling tools and limitations of the analysis
  - The impact of the COVID-19 crisis on the modelling assumptions
  - The agreed liability cashflow profiles used within the analysis and the underlying demographic assumptions
  - A description of valuation assumptions used
  - The modelling theory behind buy out probabilities and membership development

INTRODUCTION
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ASSET LIABILITY MODELLING
INVESTMENT STRATEGIES

We have set out below the investment strategies modelled, with asset allocations rounded to the nearest 5%.

Asset bucket	Asset classes	Strategy A	Strategy B	Strategy C	Strategy D
Equity	Listed equity, private equity, infrastructure equity	10%	30%	5%	-
Property	Property, CRE debt, infrastructure debt	-	5%	10%	10%
Alternative credit	Private credit, high yield, loans, multi-asset credit, high yield ABS	15%	10%	15%	
Investment grade credit	Investment grade credit, investment grade ABS, absolute return	35%	5%	30%	50%
LDI	Gilts, swaps, cash	40%	50%	40%	40%

ASSET LIABILITY MODELLING
INVESTMENT STRATEGIES

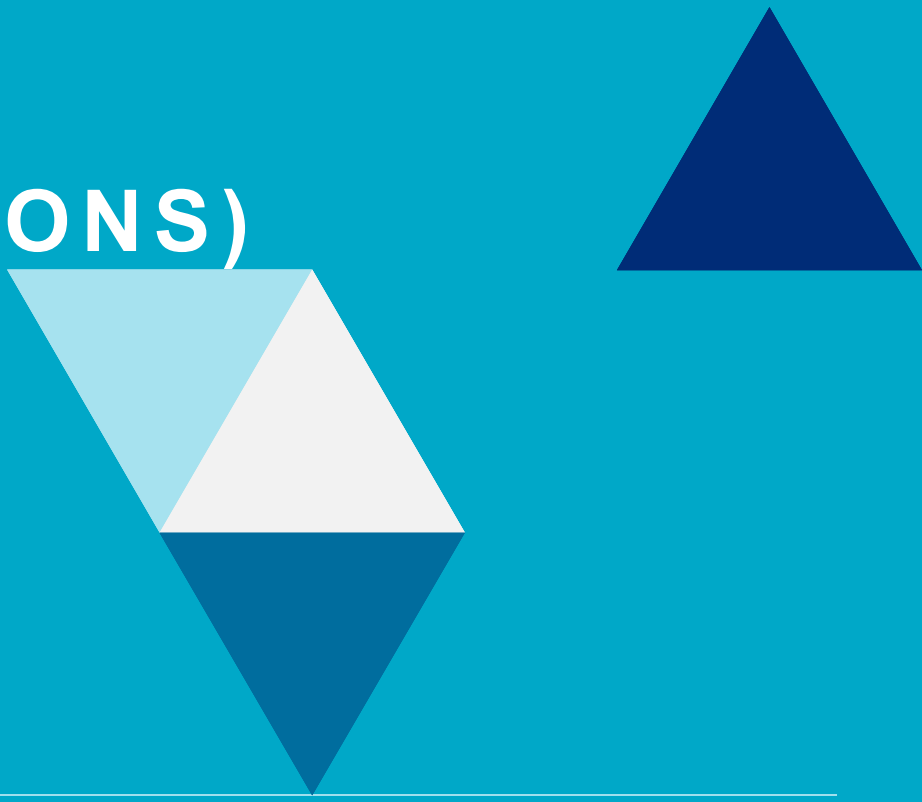
The risk and return metrics for each of the investment strategies set out on the previous page are tabulated below.

Return / risk metrics[1]	Strategy A	Strategy B	Strategy C	Strategy D
Expected return (10 year median p.a.)	**Gilts + 1.4%**	**Gilts + 1.8%**	**Gilts + 1.5%**	**Gilts + 1.0%**
Absolute volatility (1 year) [2]	5.2%	7.0%	4.9%	4.3%
Volatility relative to liabilities (1 year) [2]	**3.3%**	**5.2%**	**3.1%**	**2.2%**
Interest rate hedge ratio (funding basis)	100%	100%	100%	100%
Inflation hedge ratio (funding basis)	100%	100%	100%	100%

[1] As at 30 September 2019
[2] We suggest focussing on volatilities relative to liabilities.

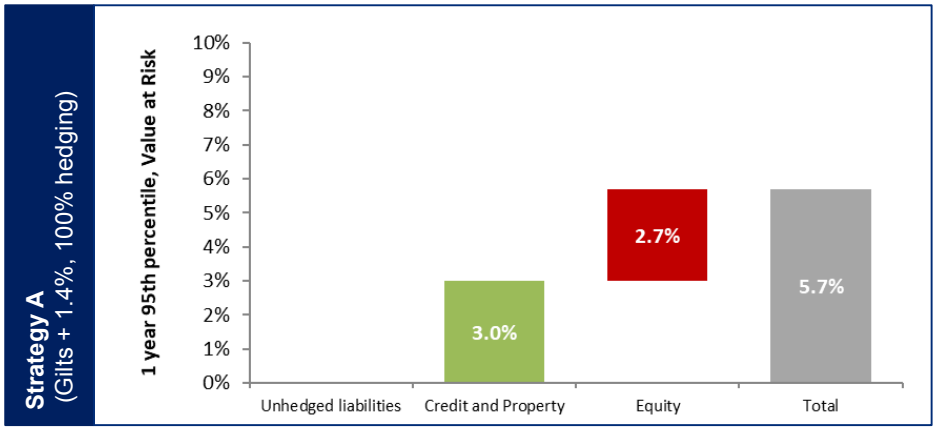
Our main analysis focuses on the first three strategies and we comment on the impact of moving to a lower risk strategy in the sensitivities section.

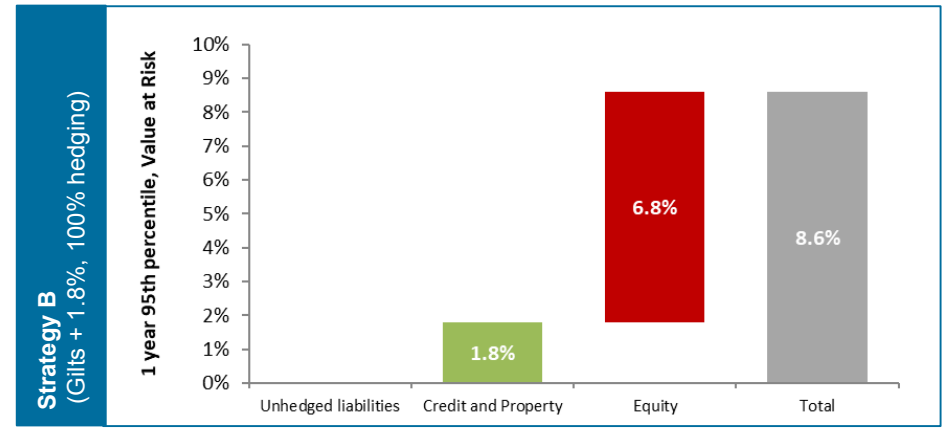
ASSET LIABILITY MODELLING (20 YEAR PROJECTIONS)

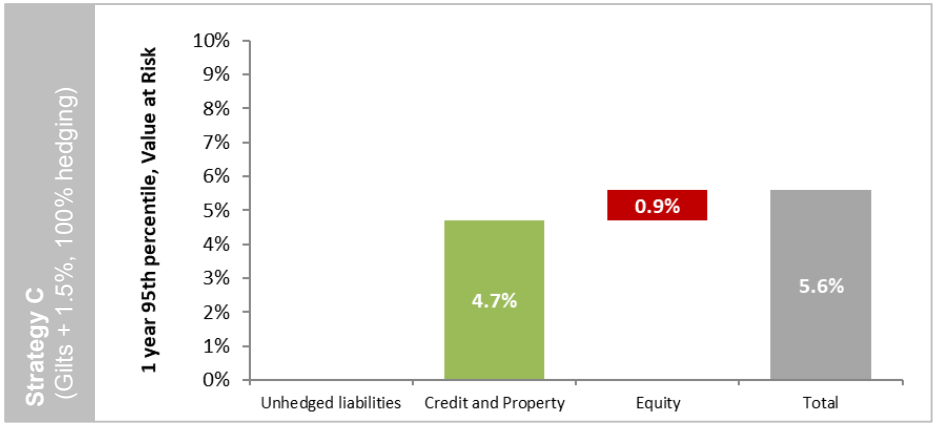


DECOMPOSITION OF RISK

The chart below shows the decomposition of risk as a percentage of the starting assets under each of the three core investment strategies, and assuming a starting buffer of 15%. Risk is defined as the 95th percentile, 1 year Value at Risk.







We note that credit based matching strategies can look less attractive from a risk perspective under VaR than under longer-term ALM projections.

This reflects that VaR is a short-term measure that focuses on the volatility of assets relative to liabilities. Over longer periods, returns on credit assets will be driven by initial and reinvestment yields and default / downgrade experience, which longer-term projections better capture.

The analysis in this section is based on Mercer's capital market assumptions as at 30 September 2019, with no allowance for longevity risk. More detail on these assumptions is shown in the appendix. Longevity risk is discussed in more detail later in this paper.

Strategy	A+B+C
Profile	50/50
Funding basis	G+0.25%
Buffer	15%

ASSET-LIABILITY MODELLING
GILTS + 0.25% FUNDING BASIS

- We have projected the assets and liabilities for the base cashflow profile (**50% pensioners / 50% deferreds**), starting from a **funding level of 100%** on the **Gilts + 0.25%** funding basis with **15% of buffer assets**.
- The table below sets out the 99th, 95th and 50th percentile funding levels, without considering the potential need for intervention.

Investment strategy	Percentile	1 year	2 years	3 years	4 years	5 years	6 years	7 years	8 years	9 years	10 years	15 years	20 years
Strategy A *Gilts + 1.4%*	99th	107%	103%	102%	101%	**101%**	101%	100%	102%	101%	**102%**	**106%**	**116%**
	95th	110%	108%	108%	108%	**108%**	109%	110%	110%	111%	**112%**	**121%**	**137%**
	50th	117%	119%	120%	122%	**125%**	127%	129%	132%	135%	**138%**	**161%**	**201%**
Strategy B *Gilts + 1.8%*	99th	103%	98%	96%	94%	**93%**	92%	91%	90%	90%	**89%**	**86%**	**83%**
	95th	107%	105%	104%	103%	**102%**	103%	102%	103%	103%	**104%**	**109%**	**120%**
	50th	117%	120%	122%	125%	**128%**	131%	134%	138%	142%	**146%**	**177%**	**233%**
Strategy C *Gilts + 1.5%*	99th	107%	104%	102%	101%	**102%**	102%	101%	102%	102%	**104%**	**111%**	**125%**
	95th	110%	109%	108%	108%	**109%**	110%	111%	112%	113%	**115%**	**126%**	**147%**
	50th	117%	119%	121%	123%	**126%**	128%	131%	134%	137%	**141%**	**166%**	**211%**

Looking at the 99th percentile at the end of year 5, a 15% buffer level is shown to be sufficient for Strategy A and C. However a larger buffer would be required for Strategy B.

Strategy	B
Profile	50/50
Funding basis	G+0.25%
Buffer	15/20/25

ASSET-LIABILITY MODELLING
GILTS + 0.25% FUNDING BASIS

- Based on the analysis on the previous slide, we have repeated the analysis **for strategy B** on a **starting buffer of 20% and 25%** and compared the results to the 15% buffer run from the previous slide.
- The table below sets out the 99th, 95th and 50th percentile funding levels, without considering the potential need for intervention.

Starting Buffer	Percentile	1 year	2 years	3 years	4 years	5 years	6 years	7 years	8 years	9 years	10 years	15 years	20 years
15%	99th	103%	98%	96%	94%	**93%**	92%	91%	90%	90%	**89%**	**86%**	**83%**
	95th	107%	105%	104%	103%	**102%**	103%	102%	103%	103%	**104%**	**109%**	**120%**
	50th	117%	120%	122%	125%	**128%**	131%	134%	138%	142%	**146%**	**177%**	**233%**
20%	99th	108%	103%	100%	99%	**98%**	97%	96%	95%	95%	**95%**	**93%**	**94%**
	95th	112%	110%	109%	108%	**107%**	108%	108%	109%	110%	**110%**	**118%**	**133%**
	50th	122%	125%	128%	131%	**134%**	138%	141%	146%	150%	**155%**	**189%**	**252%**
25%	99th	112%	108%	105%	103%	**103%**	102%	101%	101%	101%	**100%**	**100%**	**104%**
	95th	117%	114%	113%	113%	**113%**	113%	113%	115%	116%	**116%**	**126%**	**145%**
	50th	128%	131%	134%	137%	**140%**	144%	148%	153%	158%	**163%**	**202%**	**272%**

To meet the objective of being full funded with a 99% probability at the end of year 5, a buffer of around 25% would be required under Strategy B.

Strategy	A+B+C
Profile	50/50
Funding basis	G+0.5%
Buffer	15%

ASSET-LIABILITY MODELLING
GILTS + 0.5% FUNDING BASIS

- On this slide, we have projected the assets and liabilities for the base cashflow profile (**50% pensioners / 50% deferreds**), starting from a **funding level of 100%** on **the Gilts + 0.5%** funding basis with **15% of buffer assets**.
- The table below sets out the 99th, 95th and 50th percentile funding levels, without considering the potential need for intervention.

Investment strategy	Percentile	1 year	2 years	3 years	4 years	5 years	6 years	7 years	8 years	9 years	10 years	15 years	20 years
Strategy A *Gilts + 1.4%*	99th	106%	103%	101%	100%	**100%**	99%	99%	99%	99%	**99%**	**100%**	**105%**
	95th	110%	108%	107%	107%	**107%**	107%	108%	108%	108%	**109%**	**116%**	**127%**
	50th	116%	118%	120%	121%	**123%**	125%	127%	129%	132%	**135%**	**154%**	**187%**
Strategy B *Gilts + 1.8%*	99th	103%	98%	95%	93%	**92%**	90%	89%	88%	87%	**86%**	**81%**	**74%**
	95th	107%	104%	103%	102%	**101%**	101%	100%	101%	101%	**100%**	**103%**	**110%**
	50th	117%	119%	121%	124%	**126%**	129%	132%	135%	139%	**142%**	**169%**	**218%**
Strategy C *Gilts + 1.5%*	99th	107%	103%	101%	101%	**100%**	100%	99%	99%	100%	**102%**	**106%**	**116%**
	95th	110%	108%	108%	107%	**108%**	108%	109%	110%	111%	**112%**	**121%**	**137%**
	50th	117%	118%	120%	122%	**124%**	126%	129%	131%	134%	**137%**	**159%**	**197%**

Under a gilts + 0.5% basis, a 15% buffer is also sufficient for Strategies A & C. A larger buffer is necessary under Strategy B.

Strategy	B
Profile	50/50
Funding basis	G+0.5%
Buffer	15/20/25

ASSET-LIABILITY MODELLING
GILTS + 0.5% FUNDING BASIS

- Based on the analysis on the previous slide, we have repeated the analysis **for Strategy B** on a **starting buffer of 20% and 25%** and compared them to the 15% buffer run from the previous slide.
- The table below sets out the 99th, 95th and 50th percentile funding levels, without considering the potential need for intervention.

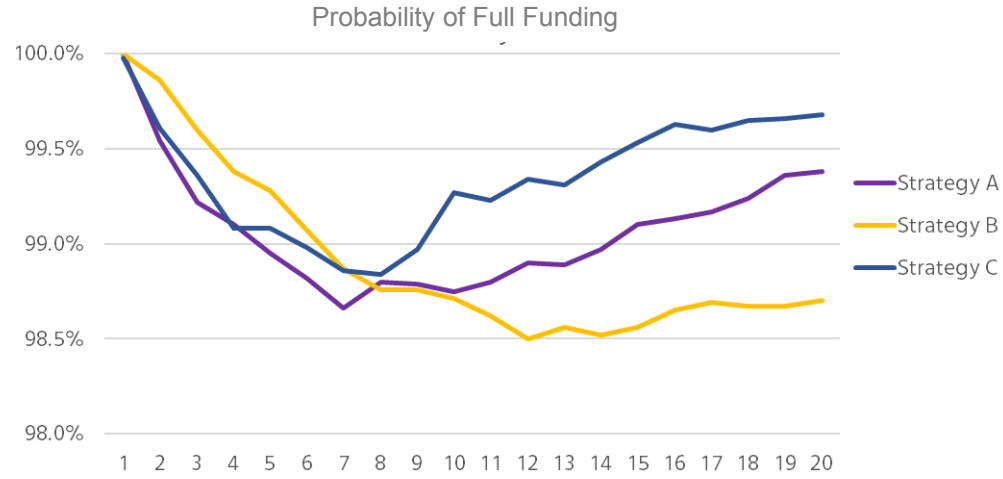
Starting Buffer	Percentile	1 year	2 years	3 years	4 years	5 years	6 years	7 years	8 years	9 years	10 years	15 years	20 years
15%	99th	103%	98%	95%	93%	**92%**	90%	89%	88%	87%	**86%**	**81%**	**74%**
	95th	107%	104%	103%	102%	**101%**	101%	100%	101%	101%	**100%**	**103%**	**110%**
	50th	117%	119%	121%	124%	**126%**	129%	132%	135%	139%	**142%**	**169%**	**218%**
20%	99th	107%	102%	99%	97%	**97%**	96%	94%	93%	93%	**92%**	**88%**	**85%**
	95th	112%	109%	108%	107%	**106%**	106%	106%	107%	107%	**107%**	**112%**	**122%**
	50th	122%	125%	127%	130%	**132%**	136%	139%	143%	147%	**151%**	**181%**	**237%**
25%	99th	112%	107%	104%	102%	**101%**	101%	99%	98%	98%	**97%**	**95%**	**96%**
	95th	116%	114%	113%	112%	**111%**	112%	111%	112%	113%	**113%**	**120%**	**135%**
	50th	127%	130%	133%	136%	**139%**	142%	146%	150%	155%	**159%**	**194%**	**256%**

Once again, our analysis implies the buffer should move to around 25% for Strategy B.

Strategy	A+B+C
Profile	50/50
Funding basis	G+0.5%
Buffer	Y

ASSET-LIABILITY MODELLING
GILTS + 0.5% FUNDING BASIS

Building on the previous slides, we now show a more detailed analysis on the probability of being fully funded over time. In this analysis **Strategies A and C** have an initial **15% buffer**; and **Strategy B** has an initial **25% buffer** in line with the aim of having a 99% likelihood of being fully funded at the 5 year point.



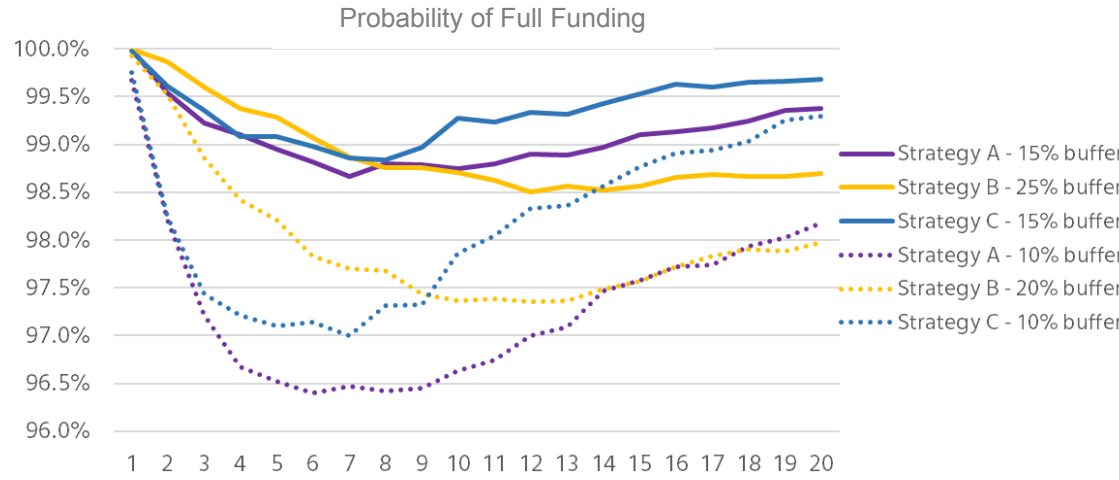
Investment Strategy	Buffer	Probability of Full Funding											
		1 year	2 years	3 years	4 years	5 years	6 years	7 years	8 years	9 years	10 years	15 years	20 years
Strategy A *Gilts + 1.4%*	15%	100.0%	99.5%	99.2%	99.1%	99.0%	98.8%	98.7%	98.8%	98.8%	98.8%	99.1%	99.4%
Strategy B *Gilts + 1.8%*	**25%**	100.0%	99.9%	99.6%	99.4%	99.3%	99.1%	98.9%	98.8%	98.8%	98.7%	98.6%	98.7%
Strategy C *Gilts + 1.5%*	15%	100.0%	99.6%	99.4%	99.1%	99.1%	99.0%	98.9%	98.8%	99.0%	99.3%	99.5%	99.7%

Under our model the likelihood of the funding level being below 100% does not increase significantly after the 5 year point in a closed system (i.e. where no profits are extracted).

Strategy	A+B+C
Profile	50/50
Funding basis	G+0.5%
Buffer	Y

ASSET-LIABILITY MODELLING
GILTS + 0.5% FUNDING BASIS

We have repeated the analysis on the previous page with a 5% lower starting buffer for each strategy.



Investment Strategy	Buffer	Probability of Full Funding											
		1 year	2 years	3 years	4 years	5 years	6 years	7 years	8 years	9 years	10 years	15 years	20 years
Strategy A *Gilts + 1.4%*	15%	100.0%	99.5%	99.2%	99.1%	99.0%	98.8%	98.7%	98.8%	98.8%	98.8%	99.1%	99.4%
	10%	99.7%	98.2%	97.2%	96.7%	96.5%	96.4%	96.5%	96.4%	96.5%	96.6%	97.6%	98.2%
Strategy B *Gilts + 1.8%*	25%	100.0%	99.9%	99.6%	99.4%	99.3%	99.1%	98.9%	98.8%	98.8%	98.7%	98.6%	98.7%
	20%	99.9%	99.5%	98.9%	98.4%	98.2%	97.8%	97.7%	97.7%	97.4%	97.4%	97.6%	98.0%
Strategy C *Gilts + 1.5%*	15%	100.0%	99.6%	99.4%	99.1%	99.1%	99.0%	98.9%	98.8%	99.0%	99.3%	99.5%	99.7%
	10%	99.8%	98.2%	97.4%	97.2%	97.1%	97.1%	97.0%	97.3%	97.3%	97.9%	98.8%	99.3%

With lower buffers, there is a significantly higher likelihood of not being fully funded, particularly in the early years.

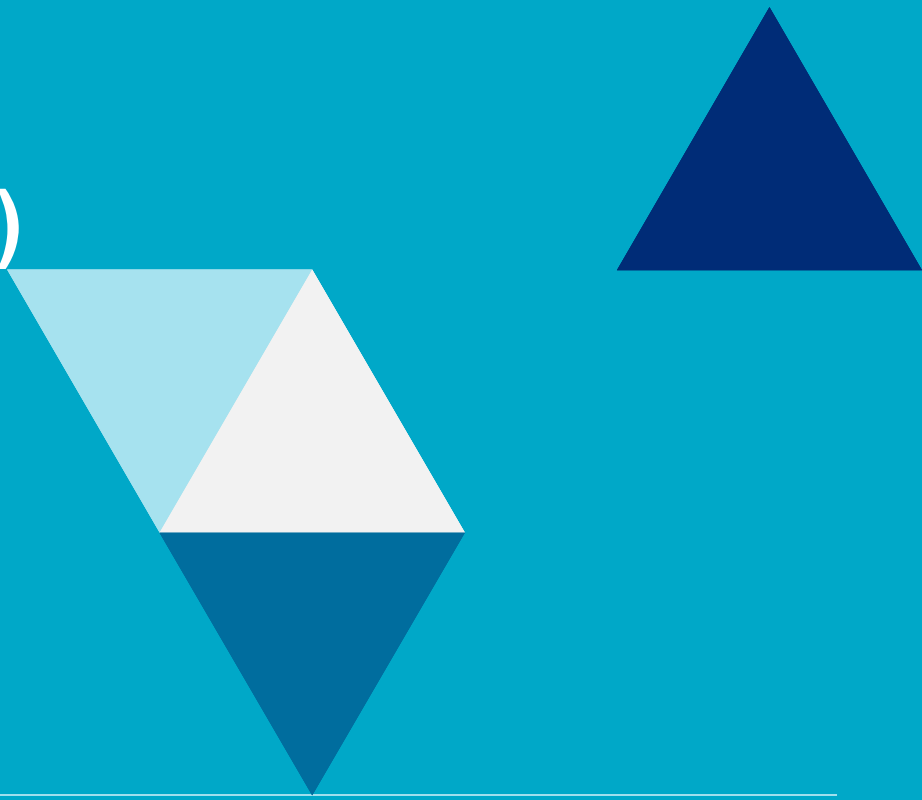
ASSET-LIABILITY MODELLING
SUMMARY

- The previous pages project the funding level over a 20-year period on both funding bases, gilts + 0.25% and gilts + 0.50%, for the base cashflow (50% pensioners / 50% deferred) profile under the following investment strategies (with expected returns as at 30 September 2019 in brackets):
    - Strategy A (Gilts + 1.4%)
    - Strategy B (Gilts + 1.8%)
    - Strategy C (Gilts + 1.5%)

- By focusing on an acceptable probability of achieving full funding at the end of year 5, these results show that a **15% buffer level is sufficient for Strategy A and C**, and a buffer of around **25% is required for Strategy B**.

- The relatively low deterioration in results resulting from changing the annualised discount rate margin in the funding basis from 0.25% to 0.5% supports the use of gilts +0.5% as a technical provisions basis. This is further tested in POMB (probability of meeting benefits) analysis that follows in the next section.

POMB ANALYTICS (PROBABILITY OF MEETING BENEFITS)



SCENARIOS MODELLED

In this section, we present the results of "Life of Scheme Analysis" which projects an initial asset base (defined by an initial funding level) over the full term of scheme cashflows. By doing this stochastically, we calculate the Probability of Meeting Benefits, which we use as a key metric to assess the security associated with a strategy. We have modelled different scenarios, on a gilts + 0.5% funding basis with a liability profile of 50% Pensioner / 50% Deferred and with stochastic allowance for longevity risk. The key characteristics modelled include:

1. The **Investment Strategy** (Strategy A, B, C and D as defined on page 6)

2. **Initial Funding Level**
   - 100% for all Strategies
   - 100% with a 15% buffer for Strategies A and C; and 100% with a 25% buffer for Strategy B (these funding levels are in line with the conclusions from the previous section)

We have assumed that the liabilities include a capitalised allowance for administrative and governance expenses and that all investment returns are net of investment management fees.

For the analysis of the proportion of schemes reaching buy-out, we have also considered Strategy D. For this analysis, the Initial Funding Level was 100% on a gilts + 0.5% basis for all strategies. A summary of the scenarios that have been modelled can be found below. We have also shown the sensitivity of the results to the discount rate and to the maturity profile

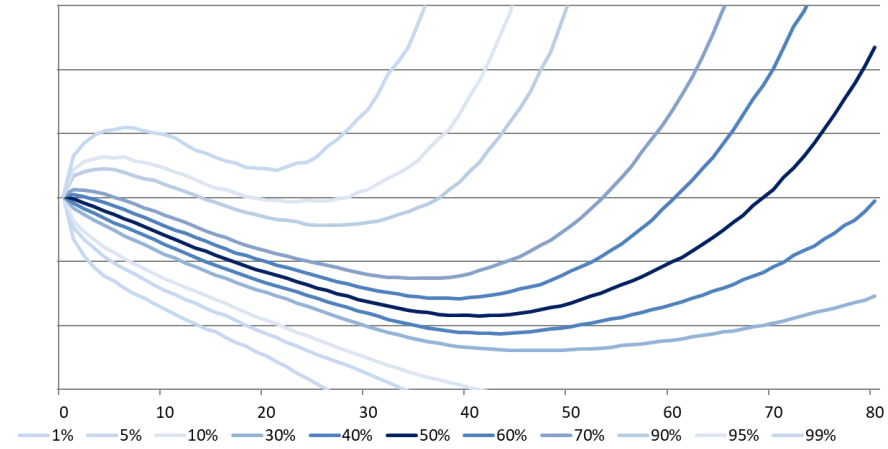
	Investment Strategy	Initial FL
A1	Strategy A	100%
A2		115%
B1	Strategy B	100%
B2		125%
C1	Strategy C	100%
C2		115%
D	Strategy D	100%

POMB ANALYSIS – SCENARIO A1

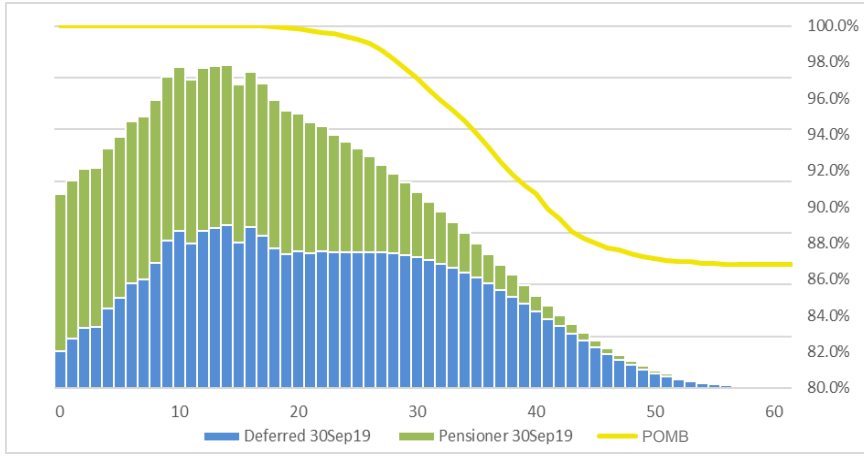
Scenario details

Liability Profile	50% Pensioner / 50% Deferred
Funding Basis (initial asset value)	Gilts + 0.5%
Investment Strategy	A
Longevity Risk modelled	Yes
Initial Funding Level	100%

Long term asset projection



Probability of meeting benefits (POMB)



Commentary

The asset projection chart (top right) shows how the assets develop under our simulations. The 99th percentile asset value reaches zero in year 27.

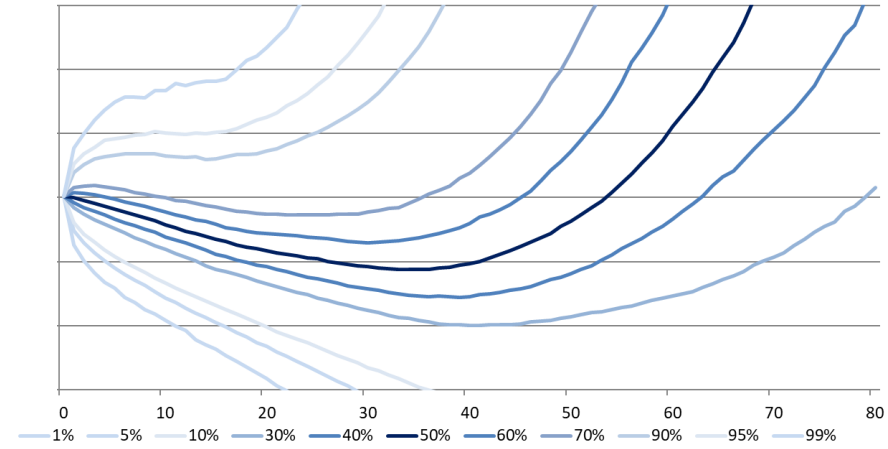
The chart on the bottom left shows the probability of having assets remaining at each time point. The yellow line ultimately reaches, at year 80, **a POMB just over 86.6%**.

POMB ANALYSIS – SCENARIO B1

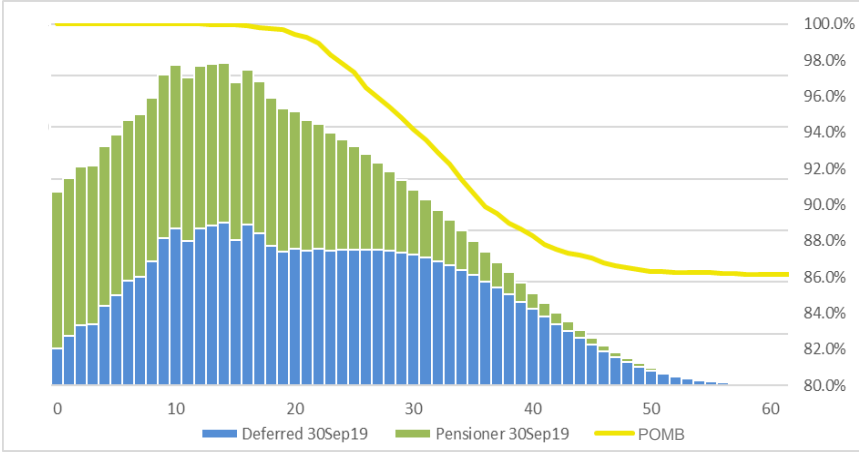
Scenario details

Liability Profile	50% Pensioner / 50% Deferred
Funding Basis (initial asset value)	Gilts + 0.5%
Investment Strategy	B
Longevity Risk modelled	Yes
Initial Funding Level	100%

Long term asset projection



Probability of meeting benefits (POMB)



Commentary

The asset projection chart (top right) shows how the assets develop under our simulations. The 99th percentile asset value reaches zero in year 22.

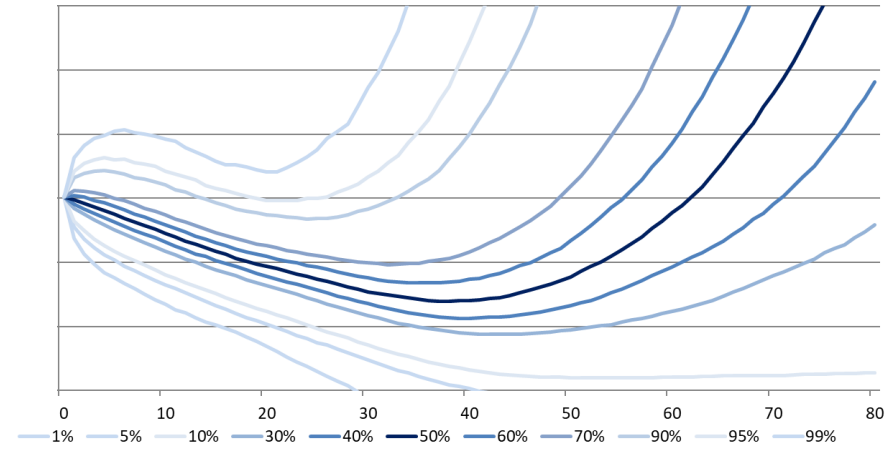
The chart on the bottom left shows the probability of having assets remaining at each time point. The yellow line ultimately reaches, at year 80, **a POMB just over 86.1%**.

POMB ANALYSIS – SCENARIO C1

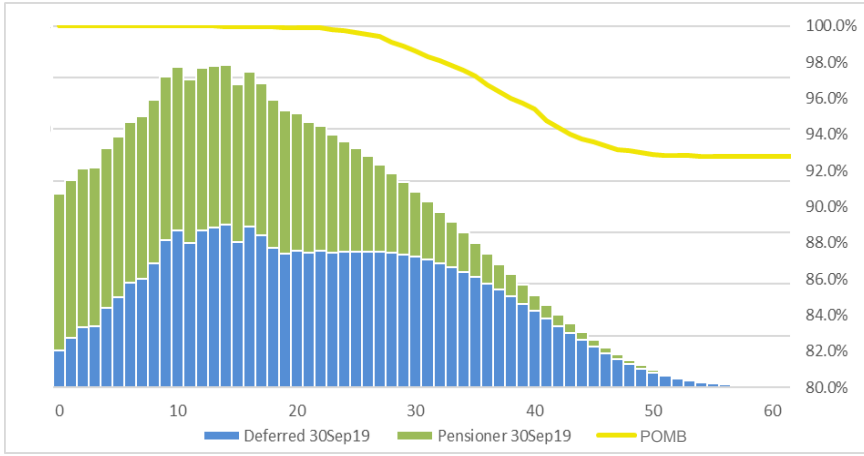
Scenario details

Liability Profile	50% Pensioner / 50% Deferred
Funding Basis (initial asset value)	Gilts + 0.5%
Investment Strategy	C
Longevity Risk modelled	Yes
Initial Funding Level	100%

Long term asset projection



Probability of meeting benefits (POMB)



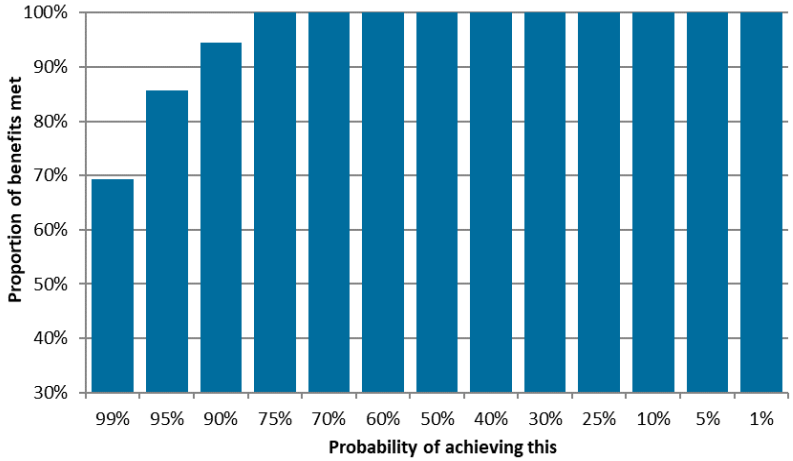
Commentary

The asset projection chart (top right) shows how the assets develop under our simulations. The 99th percentile asset value reaches zero in year 29.

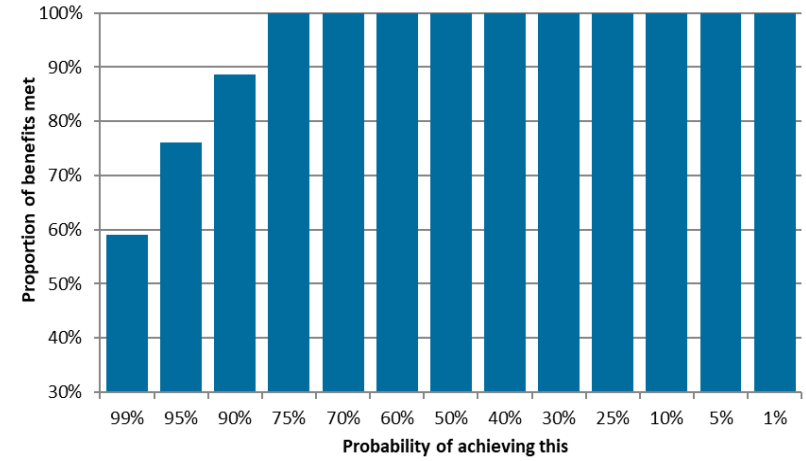
The chart on the bottom left shows the probability of having assets remaining at each time point. The yellow line ultimately reaches, at year 80, **a POMB just over 92.8%**.

PROBABILITY AND SEVERITY OF SHORTFALLS
100% INITIAL FUNDING LEVEL

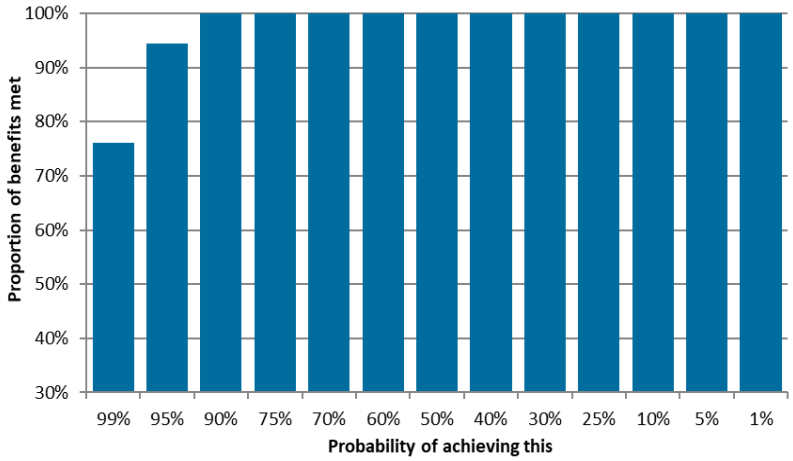
Scenario A1 – Strategy A



Scenario B1 – Strategy B



Scenario C1 – Strategy C



Commentary

These charts show the proportion of benefits met against different probability levels.

Our analysis calculates the following statistics.

Scenario	A1	B1	C1
Probability of meeting benefits	86.8%	86.1%	92.8%
Average proportion of benefits met across all scenarios	97.6%	96.7%	98.8%
Average proportion of benefits met in scenarios with less than 100% coverage	82.1%	76.5%	83.4%

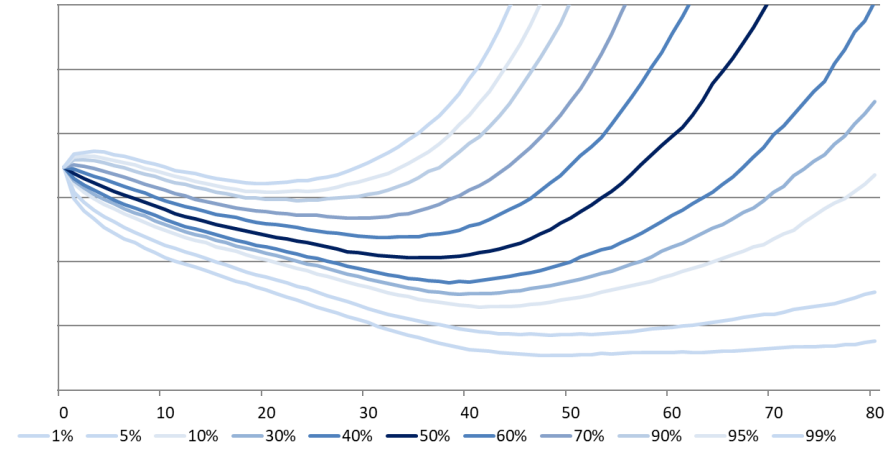
In our view, this analysis supports “gilts +0.5%” as a prudent funding basis as at 30 September 2019 in that it corresponds to a very high proportion of benefits ultimately being met, without recourse to additional funding.

POMB ANALYSIS – SCENARIO A2

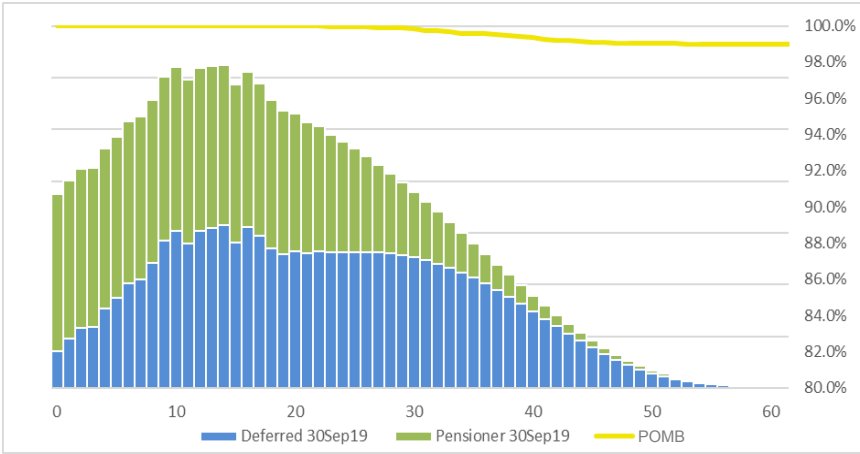
Scenario details

Liability Profile	50% Pensioner / 50% Deferred
Funding Basis (initial asset value)	Gilts + 0.5%
Investment Strategy	A
Longevity Risk modelled	Yes
Initial Funding Level	100% + **15% buffer**

Long term asset projection



Probability of meeting benefits (POMB)



Commentary

The asset projection chart (top right) shows how the assets develop under our simulations. The 99th percentile asset value never reaches zero.

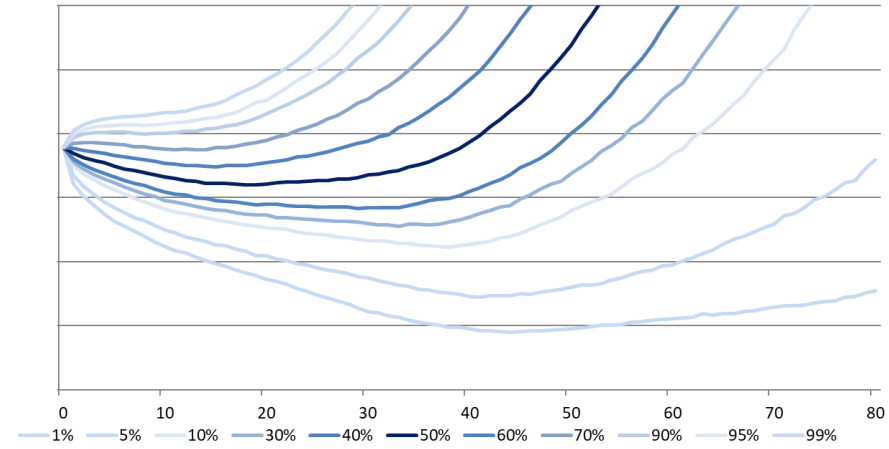
The chart on the bottom left shows the probability of having assets remaining at each time point. With 5,000 simulations the first failure is in year 23. The yellow line ultimately reaches, at year 80, **a POMB of 99.0%**.

POMB ANALYSIS – SCENARIO B2

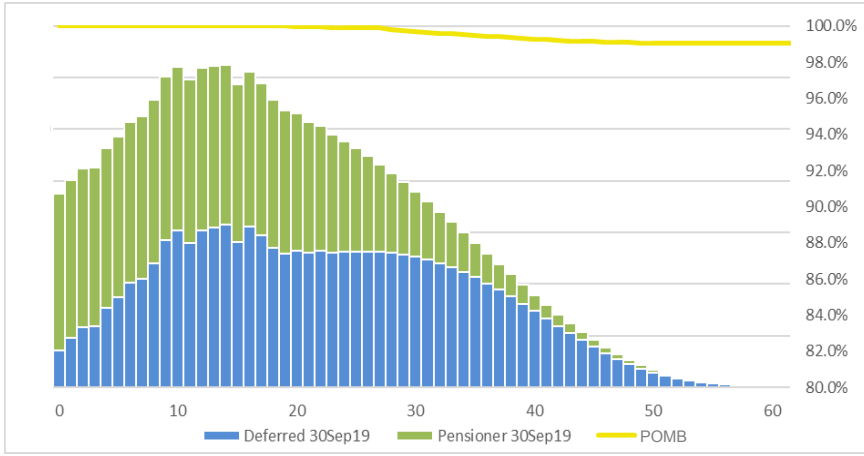
Scenario details

Liability Profile	50% Pensioner / 50% Deferred
Funding Basis (initial asset value)	Gilts + 0.5%
Investment Strategy	B
Longevity Risk modelled	Yes
Initial Funding Level	100% + **25% buffer**

Long term asset projection



Probability of meeting benefits (POMB)



Commentary

The asset projection chart (top right) shows how the assets develop under our simulations. The 99th percentile asset value never reaches zero.

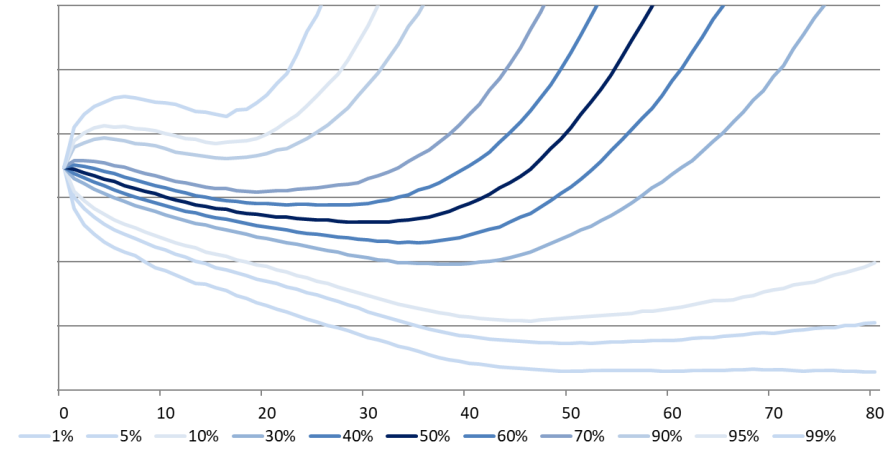
The chart on the bottom left shows the probability of having assets remaining at each time point. With 5,000 simulations the first failure is in year 20. The yellow line ultimately reaches, at year 80, **a POMB just over 99.1%**.

POMB ANALYSIS – SCENARIO C2

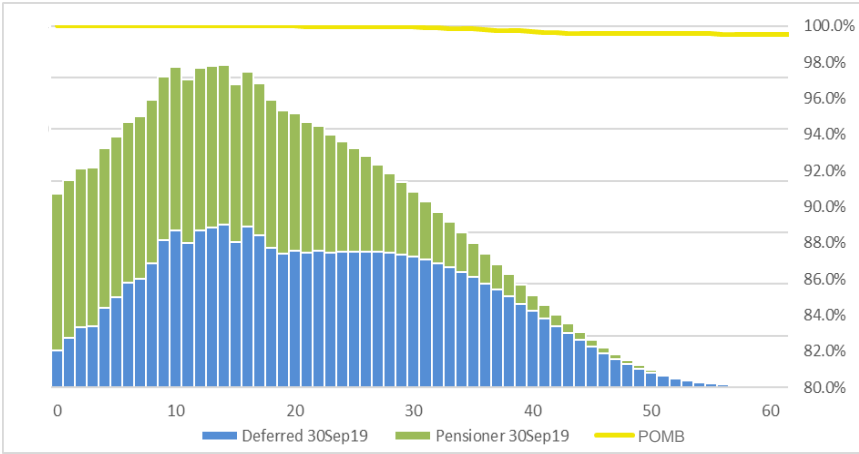
Scenario details

Liability Profile	50% Pensioner / 50% Deferred
Funding Basis (initial asset value)	Gilts + 0.5%
Investment Strategy	C
Longevity Risk modelled	Yes
Initial Funding Level	100% + **15% buffer**

Long term asset projection



Probability of meeting benefits (POMB)



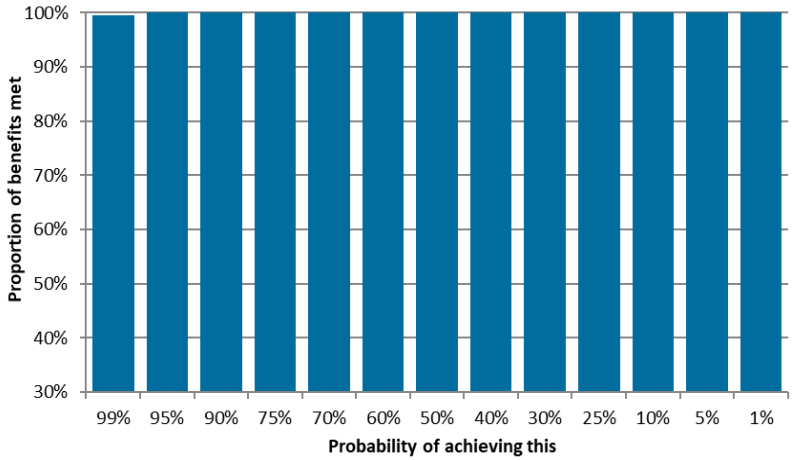
Commentary

The asset projection chart (top right) shows how the assets develop under our simulations. The 99th percentile asset value never reaches zero.

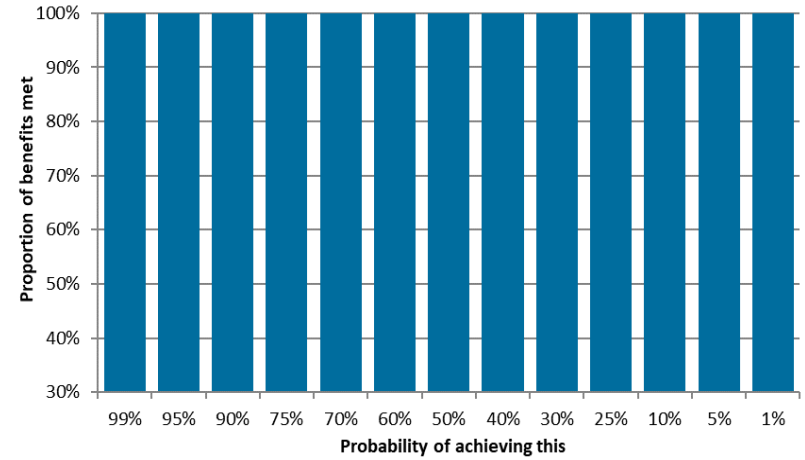
The chart on the bottom left shows the probability of having assets remaining at each time point. With 5,000 simulations the first failure is in year 21. The yellow line ultimately reaches, at year 80, **a POMB just over 99.5%**.

PROBABILITY AND SEVERITY OF SHORTFALLS
WITH BUFFER

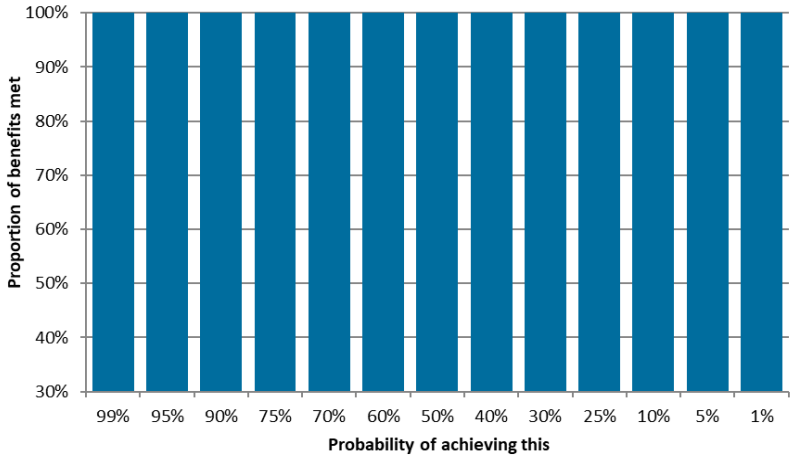
Scenario A2 - Strategy A – 115% Initial FL



Scenario B2 - Strategy B – 125% Initial FL



Scenario C2 - Strategy C – 115% Initial FL



Commentary

These charts show the proportion of benefits met against different probability levels, for **different initial funding levels**.

Our analysis calculates the following statistics.

Scenario	A2	B2	C2
Probability of meeting benefits	99.0%	99.1%	99.5%
Average proportion of benefits met across all scenarios	99.8%	99.8%	99.9%
Average proportion of benefits met in scenarios with less than 100% coverage	83.0%	78.7%	82.1%

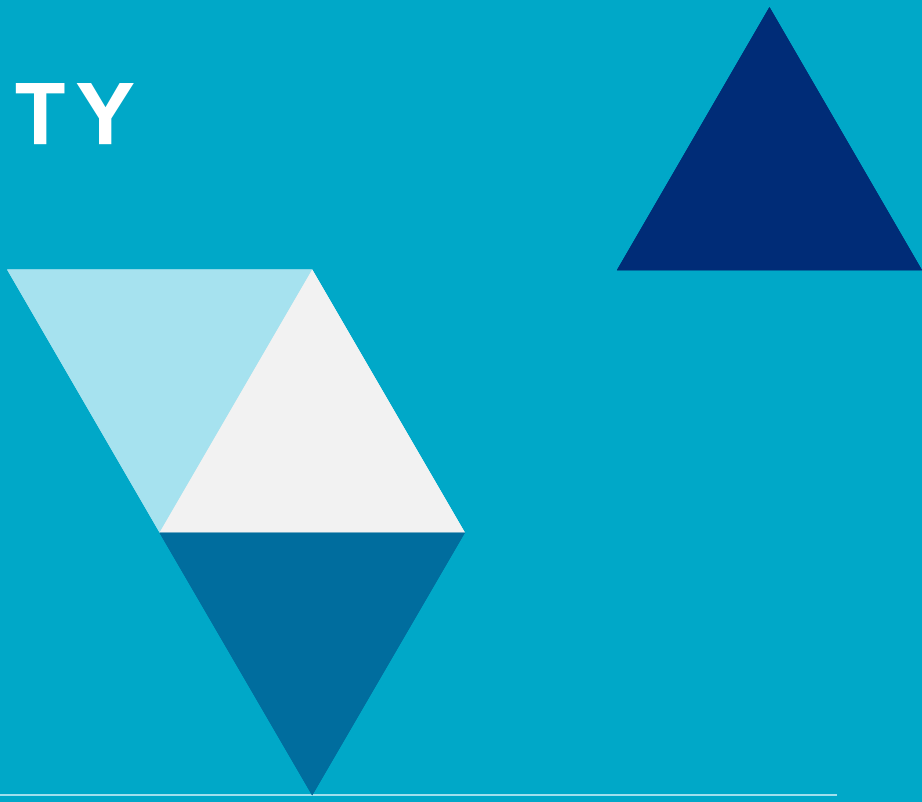
In our view, this analysis supports the conclusions of the 20 year ALM work presented earlier.

SENSITIVITY TESTS

- The table below shows the sensitivity of the POMB analysis to the discount rate of the funding basis (which determines the initial level of assets), and to changes in the liability profile.

Investment Strategy	Liability Profile	Funding Basis	POMB	Average Proportion of Benefits Paid
Strategy C	**50% Pensioner / 50% Non-pensioner**	Gilts +0.25%	96.1%	99.5%
		Gilts +0.50%	**92.8%**	**98.8%**
		Gilts +0.75%	86.0%	97.4%
	80% Pensioner / 20% Non-pensioner	Gilts +0.50%	92.0%	98.9%
	20% Pensioner / 80% Non-pensioner	Gilts +0.50%	91.9%	98.5%

CONSIDERATION OF MEMBERSHIP DEVELOPMENT AND BUYOUT PROBABILITY

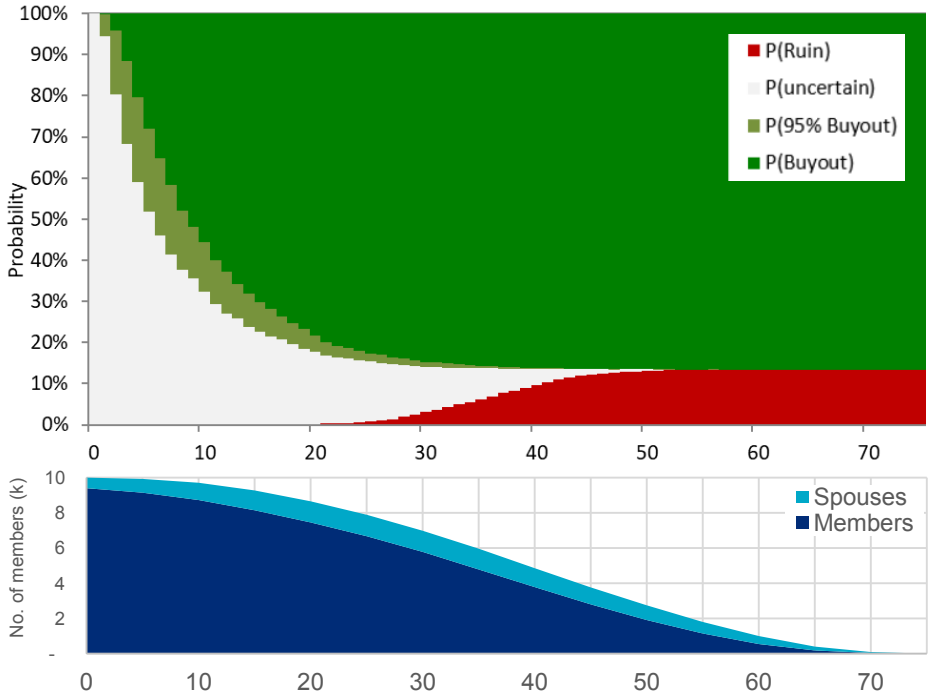


BUY OUT PROBABILITIES AND MEMBERSHIP DEVELOPMENT POMB ANALYSIS – SCENARIO A1

Scenario details

Liability Profile	50% Pensioner / 50% Deferred	Investment Strategy	A
Funding Basis (initial asset value)	Gilts + 0.5%	Longevity Risk modelled	Yes
Buy out Basis	Gilts + 0.2% pensioners Gilts - 0.5% deferred pensioners	Initial Funding Level	100%

Long term projection



Commentary

The chart on the left illustrates the development of a superfund. The red represents ruin outcomes in which assets are extinguished without meeting all benefits. Dark green represents reaching 100% funding on a proxy buy out basis. The light green area represents a funding position of 95% - 100% on the proxy buy out basis. White represents the probability of still having some assets and being below 95% on the buy out basis.

The chart at the bottom is the projection of the number of members still alive and therefore owed benefits by the scheme at a particular time.

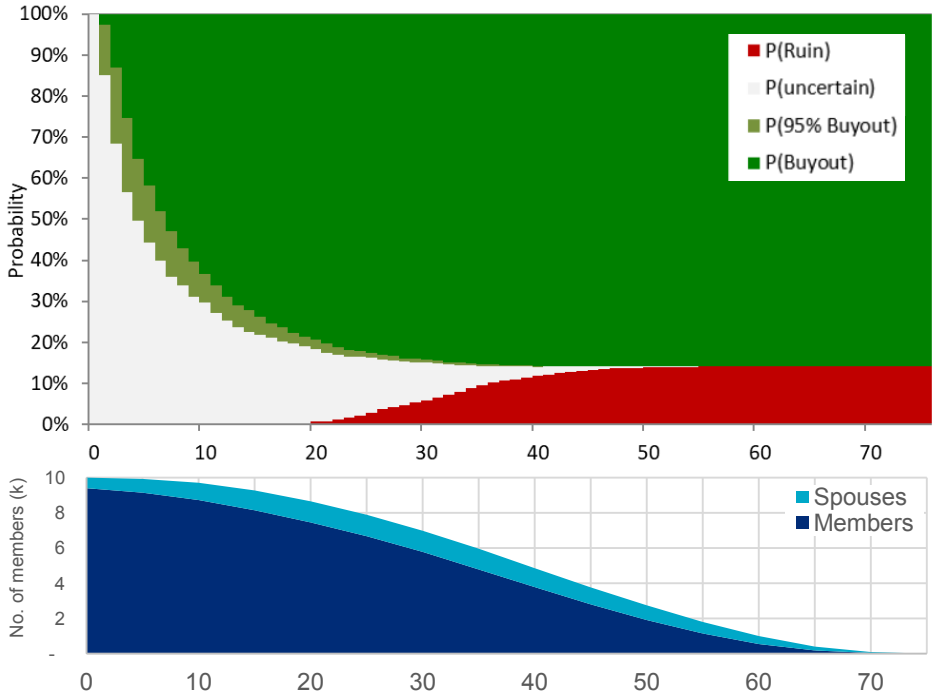
The appendix includes detail on how we modelled the buy out basis and the membership projection.

BUY OUT PROBABILITIES AND MEMBERSHIP DEVELOPMENT POMB ANALYSIS – SCENARIO B1

Scenario details

Liability Profile	50% Pensioner / 50% Deferred	Investment Strategy	B
Funding Basis (initial asset value)	Gilts + 0.5%	Longevity Risk modelled	Yes
Buy out Basis	Gilts + 0.2% pensioners Gilts - 0.5% deferred pensioners	Initial Funding Level	100%

Long term projection



Commentary

The chart on the left illustrates the development of a superfund. The red represents ruin outcomes in which assets are extinguished without meeting all benefits. Dark green represents reaching 100% funding on a proxy buy out basis. The light green area represents a funding position of 95% - 100% on the proxy buy out basis. White represents the probability of still having some assets and being below 95% on the buy out basis.

The chart at the bottom is the projection of the number of members still alive and therefore owed benefits by the scheme at a particular time.

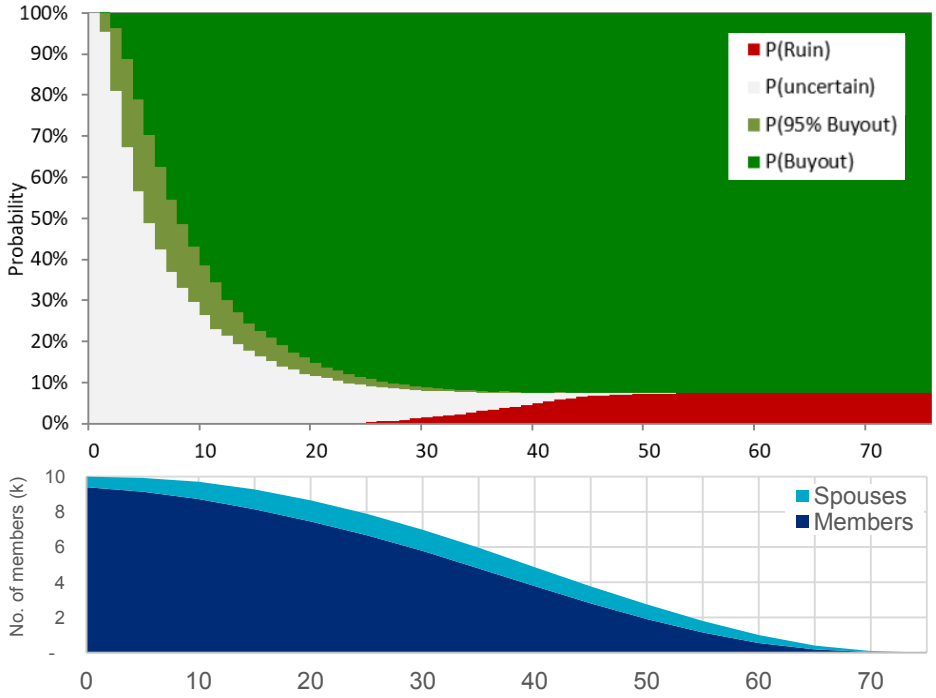
The appendix includes detail on how we modelled the buy out basis and the membership projection.

BUY OUT PROBABILITIES AND MEMBERSHIP DEVELOPMENT POMB ANALYSIS – SCENARIO C1

Scenario details

Liability Profile	50% Pensioner / 50% Deferred	Investment Strategy	C
Funding Basis (initial asset value)	Gilts + 0.5%	Longevity Risk modelled	Yes
Buy out Basis	Gilts + 0.2% pensioners Gilts - 0.5% deferred pensioners	Initial Funding Level	100%

Long term projection



Commentary

The chart on the left illustrates the development of a superfund. The red represents ruin outcomes in which assets are extinguished without meeting all benefits. Dark green represents reaching 100% funding on a proxy buy out basis. The light green area represents a funding position of 95% - 100% on the proxy buy out basis. White represents the probability of still having some assets and being below 95% on the buy out basis.

The chart at the bottom is the projection of the number of members still alive and therefore owed benefits by the scheme at a particular time.

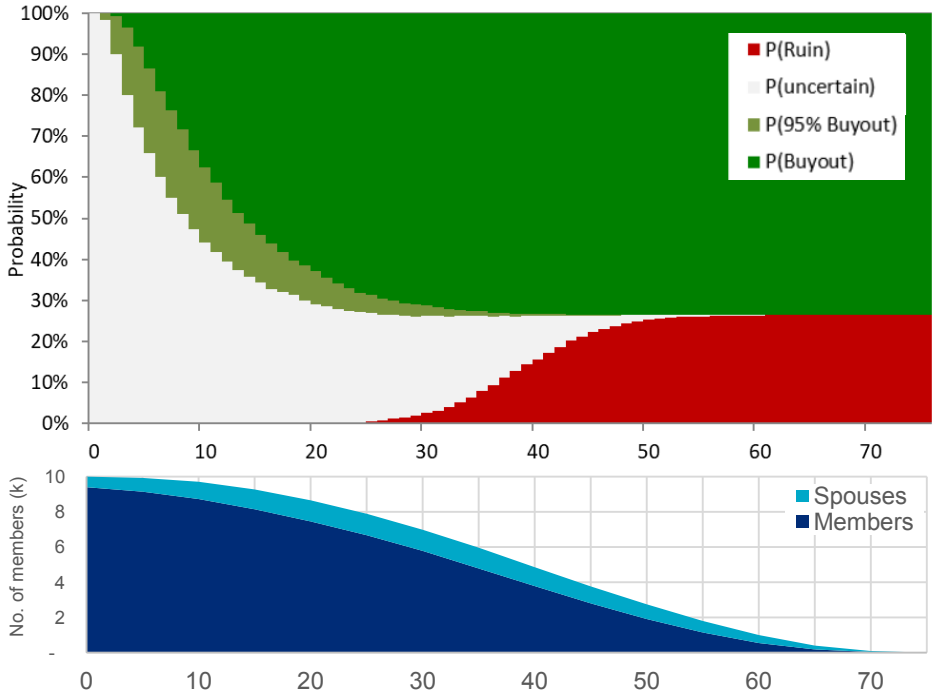
The appendix includes detail on how we modelled the buy out basis and the membership projection.

BUY OUT PROBABILITIES AND MEMBERSHIP DEVELOPMENT POMB ANALYSIS – SCENARIO D

Scenario details

Liability Profile	50% Pensioner / 50% Deferred	Investment Strategy	D
Funding Basis (initial asset value)	Gilts + 0.5%	Longevity Risk modelled	Yes
Buy out Basis	Gilts + 0.2% pensioners Gilts - 0.5% deferred pensioners	Initial Funding Level	100%

Long term projection



Commentary

The chart on the left illustrates the development of a superfund. The red represents ruin outcomes in which assets are extinguished without meeting all benefits. Dark green represents reaching 100% funding on a proxy buy out basis. The light green area represents a funding position of 95% - 100% on the proxy buy out basis. White represents the probability of still having some assets and being below 95% on the buy out basis.

The chart at the bottom is the projection of the number of members still alive and therefore owed benefits by the scheme at a particular time.

The appendix includes detail on how we modelled the buy out basis and the membership projection.

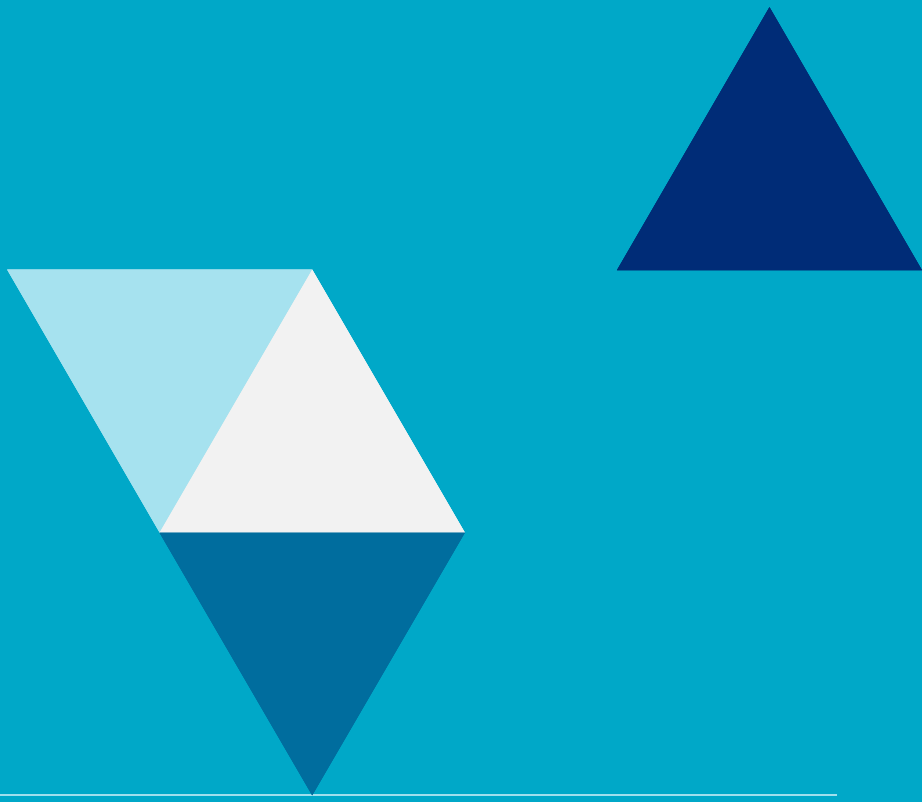
POMB ANALYSIS – SUMMARY OF FIGURES
BUY OUT PROBABILITIES AND MEMBERSHIP DEVELOPMENT

Scenario	Statistic	Yr 5	Yr 10	Yr 15	Yr 20	Yr 25	Yr 30	Yr 40	Yr 50	Yr 70
Scenario A1	**P(>100% Buyout)**	**28%**	**56%**	**70%**	**78%**	**83%**	**85%**	**86%**	**87%**	**87%**
Investment Strategy A	P(95%-100% Buyout)	20%	12%	7%	4%	2%	1%	0%	0%	0%
	P(uncertain*)	52%	32%	23%	18%	15%	11%	4%	0%	0%
	P(Ruin)	**0%**	**0%**	**0%**	**0%**	**1%**	**3%**	**10%**	**13%**	**13%**
Scenario B1	**P(>100% Buyout)**	**42%**	**63%**	**74%**	**79%**	**83%**	**84%**	**86%**	**86%**	**86%**
Investment Strategy B	P(95%-100% Buyout)	14%	7%	4%	2%	1%	1%	0%	0%	0%
	P(uncertain*)	44%	30%	22%	18%	13%	9%	2%	0%	0%
	P(Ruin)	**0%**	**0%**	**0%**	**1%**	**3%**	**6%**	**12%**	**14%**	**14%**
Scenario C1	**P(>100% Buyout)**	**30%**	**62%**	**78%**	**85%**	**89%**	**91%**	**92%**	**93%**	**93%**
Investment Strategy C	P(95%-100% Buyout)	22%	12%	6%	3%	2%	1%	0%	0%	0%
	P(uncertain*)	49%	26%	16%	11%	9%	7%	3%	0%	0%
	P(Ruin)	**0%**	**0%**	**0%**	**0%**	**0%**	**1%**	**5%**	**7%**	**7%**
Scenario D	**P(>100% Buyout)**	**13%**	**38%**	**54%**	**63%**	**69%**	**71%**	**73%**	**74%**	**74%**
Investment Strategy D	P(95%-100% Buyout)	21%	18%	12%	8%	4%	3%	0%	0%	0%
	P(uncertain*)	66%	44%	34%	29%	26%	24%	11%	1%	0%
	P(Ruin)	**0%**	**0%**	**0%**	**0%**	**1%**	**3%**	**16%**	**25%**	**26%**

*P(uncertain) represents the balance of the potential states when the other 3 have been subtracted. States which have yet to reach buyout (near to buy out or ruin). This is the white area in the charts on the previous slides.

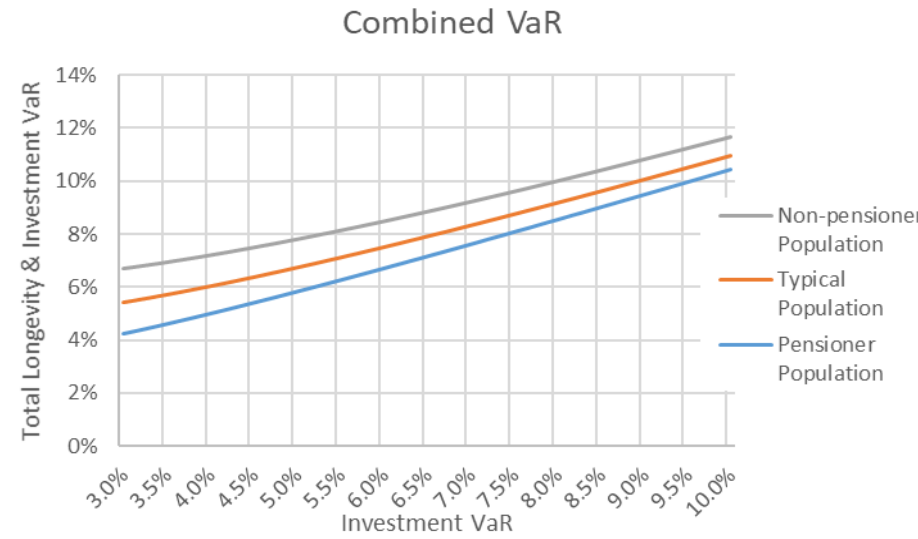
It is clear from this analysis that over half of cases will reach buy-out within 15 years and by year 25 the vast majority of cases that will reach buy-out will have done so. The majority of remaining cases at year 25 will tend to be badly funded and reach the ruin state at a later point.

LONGEVITY RISK



LONGEVITY RISK

- Longevity risk is potentially material in a superfund structure, particularly as other risks are tightly managed.
- Our 20 year ALM work, reported at the start of this paper, does not include longevity risk*. The impact of including longevity risk will be to worsen the downside scenarios (e.g. 95th and 99th percentiles) in all strategies and to reduce the probability of being fully funded in all scenarios. In effect, it increases the capital required at any point in time to reduce the probability of failure to a given level.
- The impact of allowing for longevity risk will be to make the higher risk / higher return strategies look relatively more attractive (e.g. Strategy B will look better compared to A and C). This is because for lower risk strategies longevity risk becomes a larger proportion of total risk.
- While longevity risk is difficult to model due to the lack of historic data, for a scheme with standard maturity (i.e. similar to the 50% pensioner / 50% non-pensioner profile used in this analysis), we would expect a **1 year 95% VaR event to be around a 5% deterioration in funding**. When allowing for diversification and the fact that longevity risk is broadly independent of investment risk, we get a relationship between investment VaR and total VaR as seen in the chart below.
- We would expect longevity risk to reduce as a superfund matures, given the shortening liability duration and shorter time horizon for future improvements to longevity.



** The POMB analysis does include stochastic allowance for longevity risk.*

LONGEVITY RISK

- There are two different approaches that could be adopted:
  1. Requiring superfunds to adopt a more conservative longevity assumption to value liabilities.
  2. Requiring superfunds to adopt a best estimate longevity assumption, and a capital buffer that allows for investment and longevity risk.
- Our preference on grounds of transparency is the second approach. This would also give greater consistency over the additional risk capital needed to be held against longevity risk between superfunds.
- As the table below shows, the maturity of the liabilities and the level of investment risk taken will determine the proportionate increase in buffer required.

Liability profile	Investment strategy	Investment VaR95	Longevity VaR95	Total VaR95	Ratio of Total to Investment VaR95
Pensioner	Gilts + 1.5%	6.0%	3.0%	6.7%	1.12
Non-pensioner	Gilts + 1.5%	6.0%	6.0%	8.5%	1.41
Pensioner	Gilts + 1.8%	8.0%	3.0%	8.5%	1.07
Non-pensioner	Gilts + 1.8%	8.0%	6.0%	10.0%	1.25
Pensioner	Gilts + 1.0%	4.0%	3.0%	5.0%	1.25
Non-pensioner	Gilts + 1.0%	4.0%	6.0%	7.2%	1.80

- For a superfund with a return target of gilts + 1.5% (corresponding to an investment VaR of 6%), the buffer might need to be between 1.1 and 1.4 times larger. Similarly with a return target of gilts + 1.8%, the buffer might need to be between 1.1 and 1.25 times larger.
- Where a strategy with greater derisking is adopted, a much larger proportionate increase in the buffer would be required to ensure that there is sufficient risk capital to cover longevity risk.
- **If it was decided to adopt Approach 2 above with a uniform rather than scheme-specific allowance for longevity risk, we would suggest increasing capital buffers by an addition of 3% relative to that implied by the analysis in this paper to reflect longevity risk.**

LONGEVITY
SCENARIOS MODELLED

To test the 3% figure proposed on the previous page we have consider different longevity scenarios under the POMB analysis as shown below, for a 50% Pensioner / 50% Deferred liability profile.

The analysis compares the probability of meeting benefits with and without stochastic allowance for longevity risk and assesses the additional buffer required.

A summary of the scenarios that have been modelled is shown in the table below.

Scenario	Investment Strategy	Initial Funding Level	Date of Assumptions	Longevity risk	Buffer level
C1a	Strategy C	100%	30 September 2019	No	0%
C1				Yes	0%
C3				Yes	5%

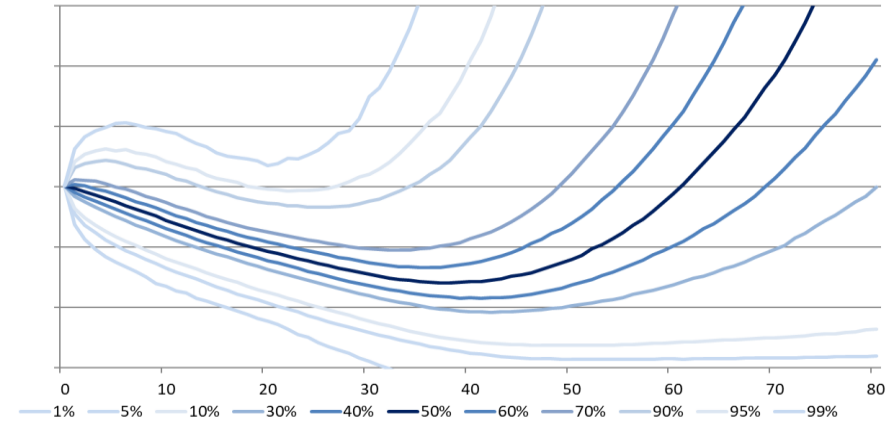
Scenario C1 was analysed earlier. We have removed the longevity risk (scenario C1a) to estimate the magnitude of the impact from longevity risk on the analysis. We then use scenario C3 to consider the additional funding required to offset the impact of the longevity risk.

LONGEVITY RISK
POMB ANALYSIS – SCENARIO C1A

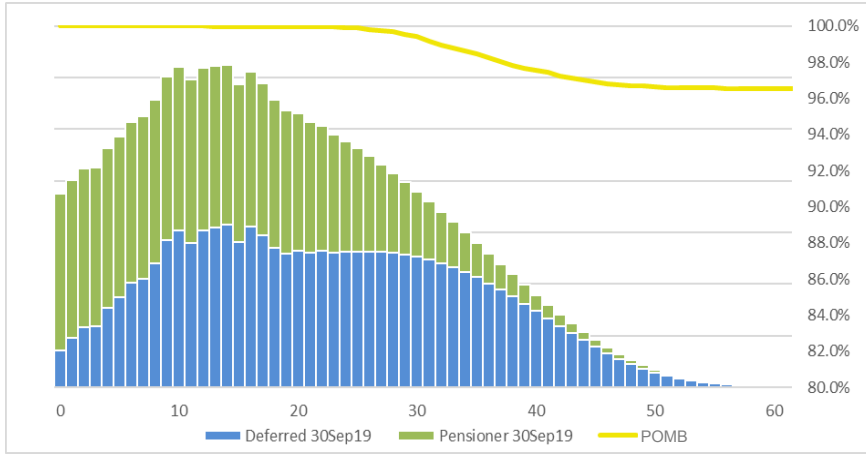
Scenario details

Liability Profile	50% Pensioner / 50% Deferred
Funding Basis (initial asset value)	Gilts + 0.50%
Investment Strategy	C
Longevity Risk modelled	No
Buffer level	0%
Initial Funding Level	100%
Date of assumptions	30 September 2019

Long term asset projection



Probability of meeting benefits (POMB)



Commentary

The asset projection chart (top right) shows how the assets develop under our simulations. The 99th percentile asset value reaches zero in year 32.

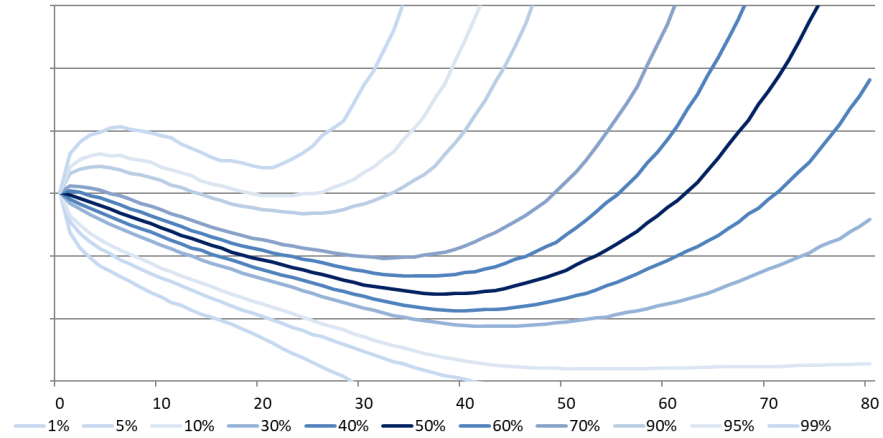
The chart on the bottom left shows the probability of having assets remaining at each time point. The yellow line ultimately reaches, at year 80, **a POMB of 96.5%**.

LONGEVITY RISK
POMB ANALYSIS – SCENARIO C1

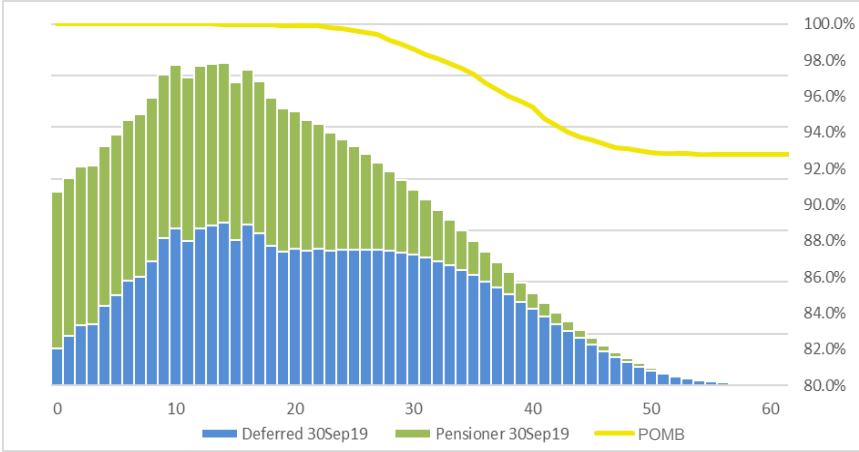
Scenario details

Liability Profile	50% Pensioner / 50% Deferred
Funding Basis (initial asset value)	Gilts + 0.50%
Investment Strategy	C
Longevity Risk modelled	Yes
Buffer level	0%
Initial Funding Level	100%
Date of assumptions	30 September 2019

Long term asset projection



Probability of meeting benefits (POMB)



Commentary

The asset projection chart (top right) shows how the assets develop under our simulations. The 99th percentile asset value reaches zero in year 29.

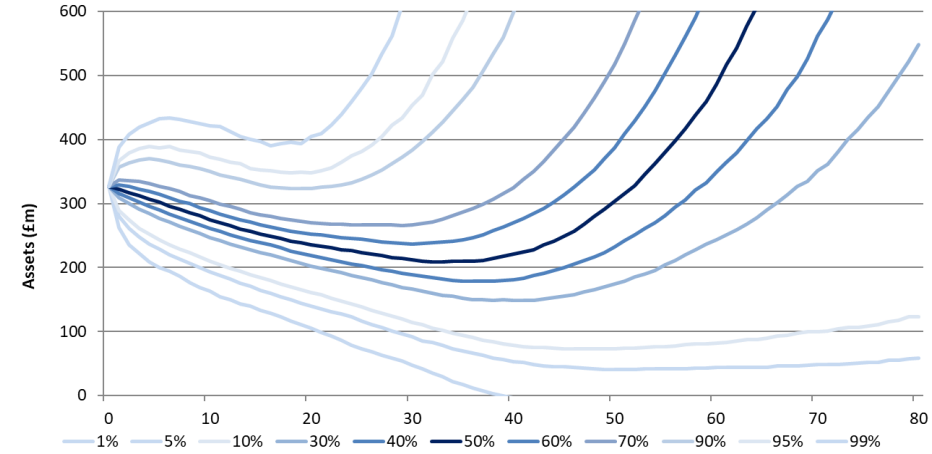
The chart on the bottom left shows the probability of having assets remaining at each time point. The yellow line ultimately reaches, at year 80, **a POMB of 92.8%**.

LONGEVITY RISK
POMB ANALYSIS – SCENARIO C3

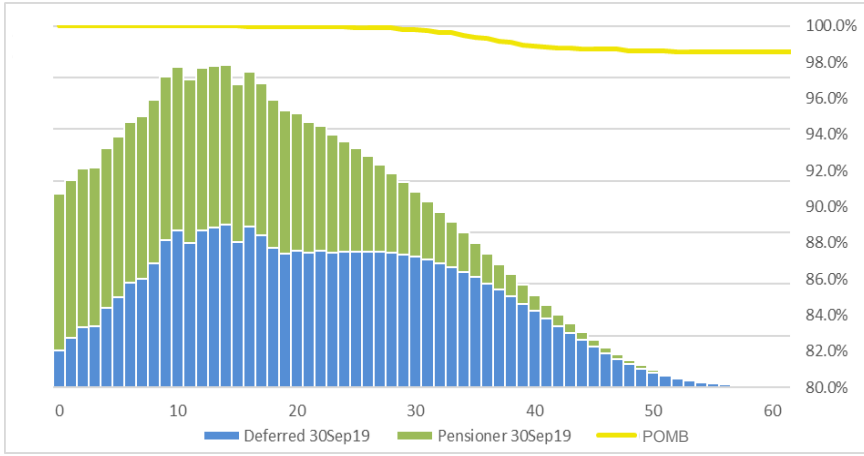
Scenario details

Liability Profile	50% Pensioner / 50% Deferred
Funding Basis (initial asset value)	Gilts + 0.50%
Investment Strategy	C
Longevity Risk modelled	Yes
Buffer level	5%
Initial Funding Level	100%
Date of assumptions	30 September 2019

Long term asset projection



Probability of meeting benefits (POMB)



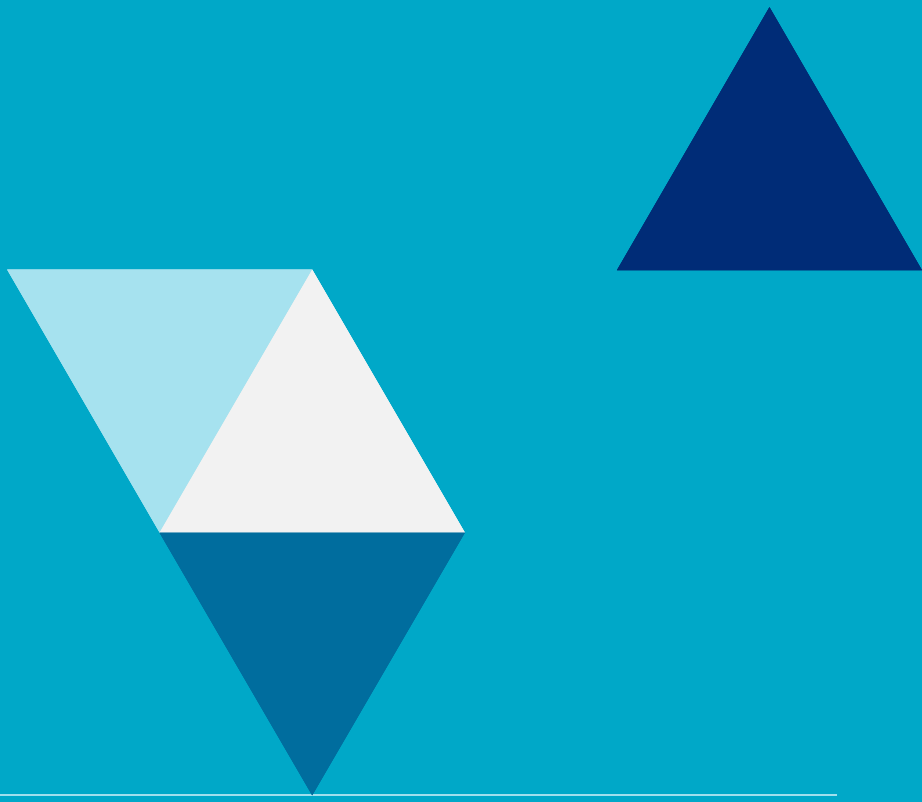
Commentary

The asset projection chart (top right) shows how the assets develop under our simulations. The 99th percentile asset value reaches zero in year 39.

The chart on the bottom left shows the probability of having assets remaining at each time point. The yellow line ultimately reaches, at year 80, **a POMB of 98.6%**.

This probability shows that a 5% buffer would be more than sufficient to cover the additional longevity risk of this liability profile (comparing to scenarios C1a and C1). **We estimate that a 3% buffer would be sufficient to cover the additional longevity risk under this analysis.** This 3% figure is consistent with the proposal on page 36.

SUPERFUNDS AND THE PPF



COMPARISON OF SCHEME AND S179 (PPF) LIABILITIES

- An additional consideration when setting triggers for intervention is the s179 funding level (i.e. the PPF basis).
- This is not a straightforward question as the s179 discount rate is lower than the gilts + 0.5% basis, leading to higher liability values. This is offset by the fact that PPF benefits are lower than full scheme benefits, on a scheme-specific basis (and the ratio will increase over time as members retire).
- The table below gives an estimated PPF funding level for a scheme that is 100% funded on a gilts + 0.5% basis, for three example membership profiles.

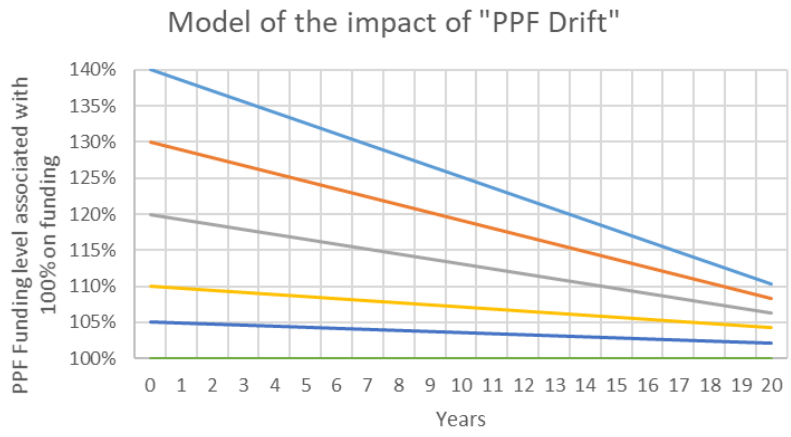
Present value of liabilities (£m)	Gilts + 0.5%
80% Pensioners / 20% Deferreds	118%
50% Pensioners / 50% Deferreds	120%
20% Pensioners / 80% Deferreds	121%

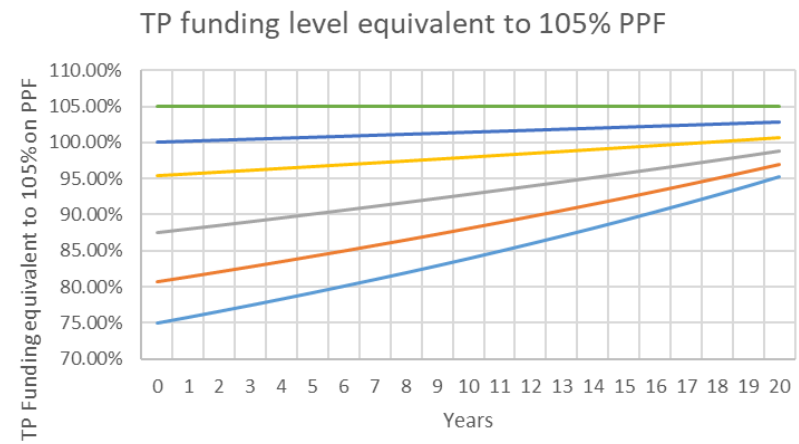
- This analysis is based on the assumptions shown in the table on the right. Other schemes with benefits closer to statutory requirements would have lower PPF funding levels, this reduction could be as high as 20%.
- We have not allowed for any benefit caps being applied.
  In schemes with high individual pensions, this could be significant.
- **In our view, there would be little benefit in amending the intervention trigger to be based on the s179 funding level, unless there was a scheme-specific adjustment applied to reflect the difference in liabilities between the PPF and full scheme benefits.**

Bases	PPF	Funding
Pre-retirement discount rate margin	0.30%	0.50%
Post-retirement discount rate margin	-0.15%	0.50%
Average revaluation rate	2.90%	3.25%
Average pensioner pension increase	1%	3%
Average deferred pension increase	1.50%	3%
Deferred benefit reduction	90%	100%

PPF TRIGGERS

- Below we consider the probability of a superfund or individual scheme within a superfund falling below a trigger of 105% funded on the PPF basis. This is clearly very dependent on the specifics of the membership profile and the benefit structure.
- As a guide we have considered different PPF funding levels associated with being 100% funded on the funding basis of gilts +0.5%. We have assumed that any surplus measure (i.e. the extent to which being 100% funded on a gilts + 0.5% basis implies a surplus on a PPF basis) reduces over time due to "PPF drift" (e.g. members reach normal pension age and become eligible to greater benefits within the PPF and pension increases are awarded and crystallised which would not have been awarded in the PPF).
- We have assumed that schemes with a greater PPF surplus will experience a greater proportionate PPF drift on the basis that we expect more of these will be related to members below normal pension age and these benefit reductions will cease on reaching normal retirement age. Whereas smaller variations are more likely to be driven by differences in pension increases which will reduce but not cease over time.
- Our modelling assumes that the first 10% of PPF surplus falls linearly to zero over 35 years, and additional PPF surplus falls linearly to zero over 25 years. We stress that this is representative only and that specific schemes could behave very differently. The following charts illustrate the development of the PPF funding level implied by a 100% position on the gilts + 0.5% basis and the trigger on a funding basis which is equivalent to the 105% PPF trigger.

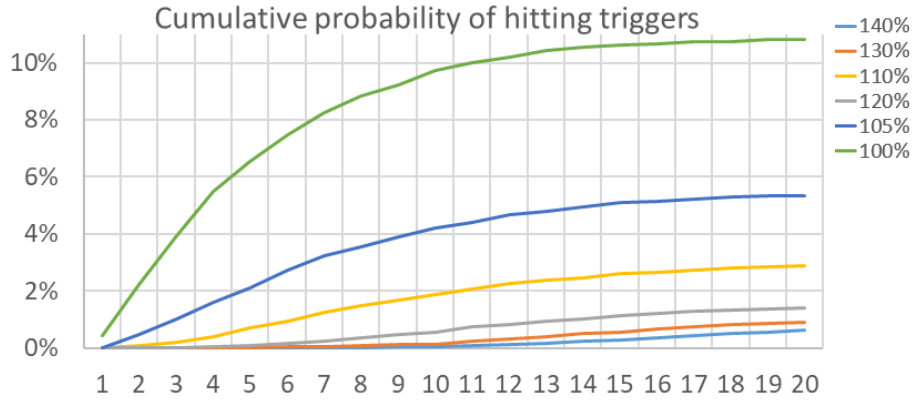




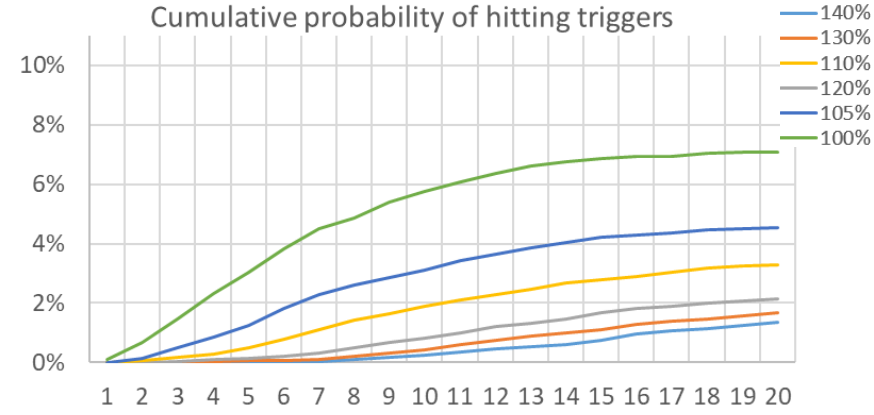
PPF TRIGGERS

- This page shows the cumulative probability of breaching a 105% PPF funding level triggers in any given year for different initial ratios of PPF funding to funding on the Gilts + 0.5% basis. Assets are assumed to be 100% of Gilts + 0.5% liabilities plus a buffer in line with conclusions of previous analysis (i.e. 15% or 25%). The calculation allows for PPF drift as described on the previous page.

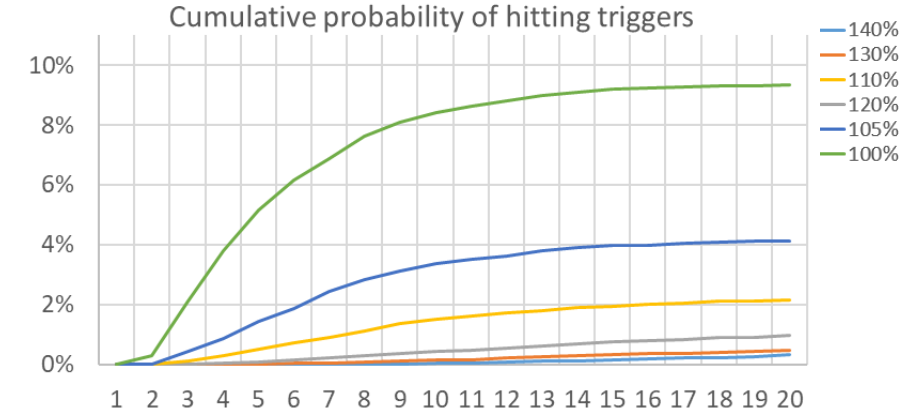
Strategy A – Gilts + 1.4%, 15% buffer



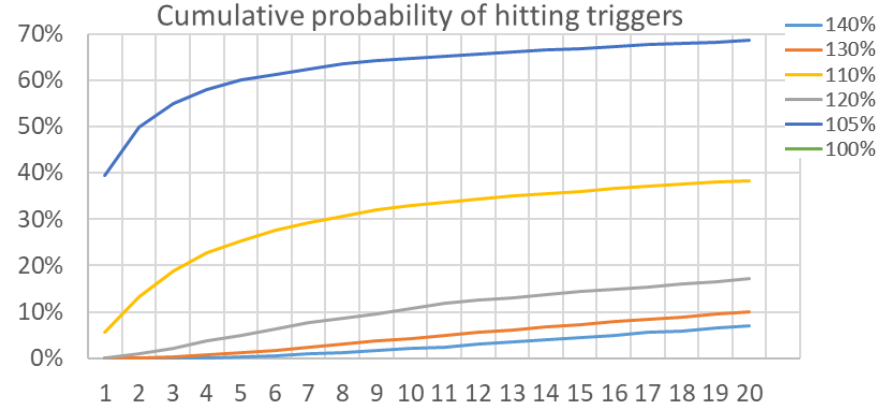
Strategy B – Gilts + 1.8%, 25% buffer



Strategy C – Gilts + 1.5%, 15% buffer



Strategy C - Gilts + 1.5%, 0% buffer



PPF TRIGGER ANALYSIS

PROBABILITY OF HITTING A PPF TRIGGER UP TO A GIVEN YEAR

Investment Strategy	Initial PPF level associated with 100% gilts +0.5%	1 year	2 years	3 years	4 years	5 years	6 years	7 years	8 years	9 years	10 years	15 years	20 years
Strategy A Gilts + 1.4% 15% buffer	140%	0.00%	0.00%	0.00%	0.02%	0.02%	0.02%	0.03%	0.03%	0.04%	0.06%	0.29%	0.63%
	130%	0.00%	0.00%	0.01%	0.02%	0.03%	0.05%	0.07%	0.09%	0.12%	0.14%	0.55%	0.92%
	120%	0.00%	0.01%	0.02%	0.07%	0.09%	0.18%	0.24%	0.36%	0.49%	0.57%	1.13%	1.40%
	110%	0.00%	0.09%	0.22%	0.42%	0.71%	0.96%	1.26%	1.49%	1.67%	1.89%	2.61%	2.88%
	105%	0.00%	0.50%	1.04%	1.62%	2.11%	2.72%	3.23%	3.57%	3.89%	4.22%	5.12%	5.35%
	100%	0.44%	2.23%	3.95%	5.50%	6.56%	7.46%	8.24%	8.84%	9.24%	9.71%	10.62%	10.82%
Strategy B Gilts + 1.8% 25% buffer	140%	0.00%	0.00%	0.01%	0.01%	0.02%	0.04%	0.04%	0.10%	0.16%	0.23%	0.74%	1.34%
	130%	0.00%	0.00%	0.01%	0.02%	0.05%	0.07%	0.10%	0.20%	0.32%	0.42%	1.12%	1.66%
	120%	0.00%	0.01%	0.02%	0.09%	0.14%	0.22%	0.32%	0.51%	0.69%	0.81%	1.67%	2.14%
	110%	0.00%	0.06%	0.16%	0.29%	0.51%	0.79%	1.12%	1.42%	1.65%	1.89%	2.79%	3.28%
	105%	0.00%	0.15%	0.48%	0.87%	1.25%	1.81%	2.27%	2.61%	2.85%	3.10%	4.20%	4.53%
	100%	0.09%	0.66%	1.45%	2.31%	3.04%	3.84%	4.49%	4.86%	5.38%	5.77%	6.85%	7.09%
Strategy C Gilts + 1.5% 15% buffer	140%	0.00%	0.00%	0.00%	0.00%	0.01%	0.01%	0.01%	0.01%	0.01%	0.04%	0.16%	0.34%
	130%	0.00%	0.00%	0.00%	0.00%	0.02%	0.03%	0.06%	0.08%	0.12%	0.16%	0.33%	0.49%
	120%	0.00%	0.00%	0.01%	0.03%	0.07%	0.17%	0.24%	0.31%	0.38%	0.43%	0.76%	0.96%
	110%	0.00%	0.00%	0.11%	0.29%	0.50%	0.74%	0.90%	1.13%	1.36%	1.50%	1.94%	2.15%
	105%	0.00%	0.02%	0.44%	0.87%	1.44%	1.88%	2.43%	2.84%	3.13%	3.37%	3.99%	4.13%
	100%	0.00%	0.31%	2.12%	3.82%	5.15%	6.16%	6.89%	7.64%	8.11%	8.43%	9.19%	9.34%
Strategy C Gilts + 1.5% 0% buffer	140%	0.00%	0.02%	0.06%	0.16%	0.38%	0.56%	0.96%	1.30%	1.72%	2.10%	4.42%	7.10%
	130%	0.00%	0.12%	0.30%	0.74%	1.10%	1.68%	2.34%	3.08%	3.64%	4.26%	7.26%	10.10%
	120%	0.04%	0.98%	2.08%	3.66%	4.96%	6.36%	7.68%	8.68%	9.60%	10.68%	14.32%	17.08%
	110%	5.72%	13.14%	18.72%	22.66%	25.30%	27.60%	29.34%	30.64%	32.10%	32.96%	35.94%	38.34%
	105%	39.38%	49.90%	54.88%	57.98%	60.08%	61.32%	62.34%	63.54%	64.22%	64.62%	66.84%	68.60%
	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%

PPF TRIGGERS
GILTS + 0.5% FUNDING BASIS

The analysis on the previous pages shows that the likelihood of the 105% PPF trigger being breached is generally lower than that of the 100% funding level trigger being breached (comparing to analysis in the 20 year ALM section).

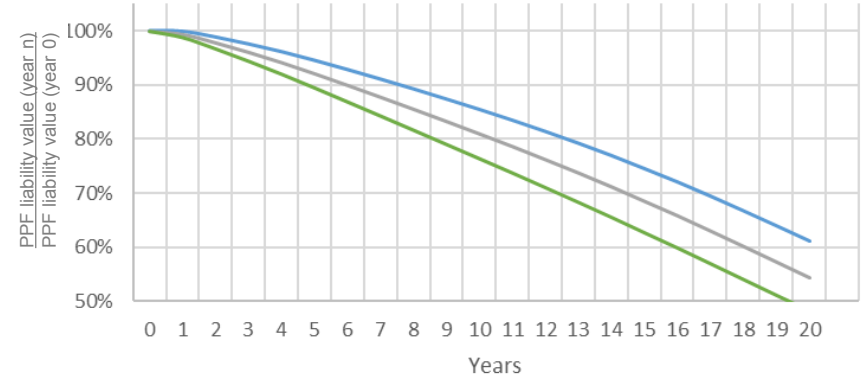
The only exception is where full scheme benefits are very close to PPF benefits, in which case towards the end of the 20 year period shown, it is likely that 105% of PPF liabilities will be higher than 100% of scheme liabilities.

This is as expected based on the PPF drift analysis shown on the previous page. The analysis does serve to illustrate the importance of understanding the relationship between full scheme and PPF benefits.

Additionally, Strategy C was ran without the starting buffer, i.e. it considers the post intervention situation, after a superfund has hit an intervention trigger and the superfund is closed and is being run-off. Clearly starting from 100% funding the likelihood of hitting the PPF trigger is greatly increased particularly in situations where the PPF benefits are closer to the full scheme benefits.

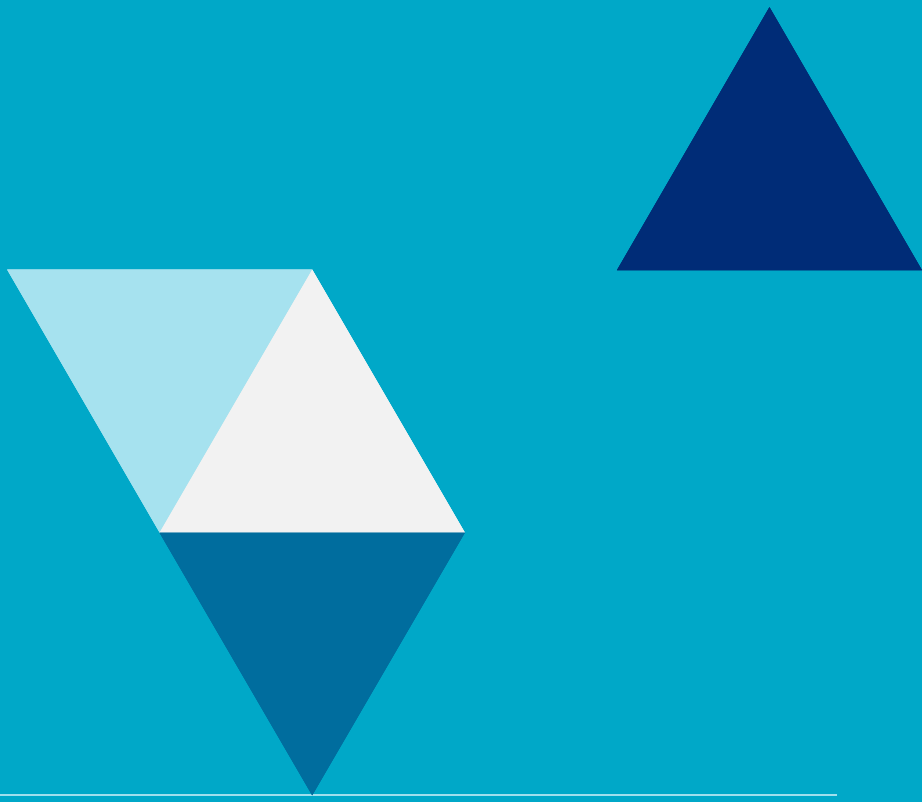
In analysing the risks relating to a superfund or section of a superfund, hitting the intervention trigger implies funding challenges relating to covering PPF benefits over an extended period, therefore it is worth considering the fact that the magnitude of the outstanding liability, and hence risk, reduces over time.

To illustrate this, this chart shows the value of PPF liabilities in a given year as a proportion of the initial PPF liability value. Using the same colours as on page 44, the blue line relates to a scheme where 100% funding on a gilts +0.5% equates to 140% on PPF basis / benefits. The grey line equates to a 120% PPF to funding basis ratio and the green line assumes that PPF and funding bases give equal liability values. The reason for the different paths is that the scheme starting with a greater PPF funding level experiences greater PPF drift. It also shows that at year 20 the PPF liability value is expected to have fallen by 40%– 50%.



These figures are based on the 50% pensioner profile and would be sensitive to variation in maturity.

OTHER CONSIDERATIONS



SENSITIVITY ANALYSIS

We have carried out sensitivity analysis of the 20 year ALM projections to understand the impact of varying the level of interest rate and inflation hedging, varying the maturity of the liabilities, and whether a materially lower risk investment strategy improves outcomes. The results are summarised below:

Interest rate and inflation hedging levels

- Reducing the level of interest rate and inflation hedging to 75% rather than 100% does not materially worsen the downside outcomes. Therefore we recommend that the superfunds are given flexibility to set hedging levels between 100% and 75%.

Liability maturity

- Varying the maturity of the liability profile did not materially impact the performance of the strategies relative to the 50% pensioner / 50% non-pensioner profile. We therefore suggest that there is no need for the framework to vary according to the maturity profile of the liabilities.

Reducing investment risk

- Reducing investment risk (for example by moving to the gilts + 1.0% strategy shown earlier in this deck) does not materially improve the performance of the strategy compared to Strategies A & C. Incorporating longevity risk would worsen the relative performance of the lower risk strategy. We therefore do not think that TPR should look to require a materially lower level of investment risk than implied by Strategies A & C unless intervention has been triggered.

EXPENSES

- **We recommend that each superfund approximates their future expenses and capitalises their estimate into the liability value. We have used this approach in our modelling throughout.**
- In relation to the expenses for administering benefit payments, we suggest the approach set out in the PPF valuation guidance of applying a capitalised value of £1,000 for deferred members and around £800 for pensioners is also used by the superfunds.
- To estimate the number of members in a scheme, we have assumed an average pension of £5,000. Clearly this will vary materially by scheme. Based on this assumption, the capitalised value will add around 0.6% of the liability value. Due to the per member nature of this model, there are no economies of scale for this element of expenses.
- The other area of expense would be around governance covering internal staff and external professional advisors. This is an area where economies of scale would be expected.
- The table below sets out the expected expense loading for superfunds with total liabilities of £1bn, £5bn and £20bn. This analysis includes the expected cost of administration and governance. Note that investment management fees and expenses are excluded as our modelling is based on returns net of fees.

Present value of expenses	£1bn superfund	£5bn superfund	£20bn superfund
Benefit administration	0.6%, £6m	0.6%, £30m	0.6%, £120m
Governance and advice	3.0%, £30m	1.5%, £75m	1.0%, £200m
Total expenses	**3.6%, £36m**	**2.1%, £105m**	**1.6%, £320m**

- We have ignored PPF levies in these calculations on the basis that the strength of funding is likely to mean these are not material.
- We have not included a £0.5bn fund in the table as we would expect the governance costs, in £ terms, to be similar to the £1bn superfund above leading to a high rate as a percentage of assets.

EXPENSES

- We have considered the risk that expenses exceed the level assumed within a capitalised expense reserve.
- The table below sets out the impact of an additional £1m spending per annum over a 5-year and 10-year period.

Total liability (£m)	1,000	5,000	20,000
£1m p.a. additional expense for 5 years	0.5%	0.1%	0.025%
Implied remaining buffer after allowing for effective loss to expenses	14.5%	14.9%	14.975%
£1m p.a. additional spending for 10 years	1.0%	0.2%	0.05%
Implied remaining buffer after allowing for effective loss to expenses	14.0%	14.8%	14.95%

Our view is that if an expense reserve is included as part of the liability value and actual expenses drawn are connected to those reserved for, expense risk is relatively limited. Expense experience will need to be monitored within the ongoing supervision framework (alongside other experience items).

INVESTMENT CONCENTRATION RISKS

- Within our analysis we have assumed that superfunds invest in a diversified portfolio within each asset class.
- This would require that concentration risk is appropriately managed within each asset class and at an overall level in respect of the following: security level, issuer level, industry sector.
- The overall principles should be:
  1. The superfund does not hold an excessive proportion of any individual security or an issuer's debt and/or equity;
  2. The superfund does not hold an excessive proportion of its assets in any one security, issuer or industry.
- We suggest suitable limits might be as follows:
  1. 5% limit of the total issuance of a security and 2.5% limit of an issuer's total debt and equity issuance (including subsidiaries and associated companies, excluding government bonds rated AA or higher) across all sections of a superfund. Measured at an overall level across all mandates with look-through.
  2. Maximum allocation of 1% to a single security, 2% to a single issuer (excluding Government bonds rated AA or higher) within each section of a superfund. Measured for each section across all mandates with look-through.
- Concentration risk by industry (e.g. financials) or country should also be monitored through the supervision regime.

REINVESTMENT RISK

How has reinvestment risk been modelled?

- We have allowed for reinvestment risk. Investment grade credit has been assumed to cover a cashflow profile in line with the over 15 year index, and is modelled on a buy and hold basis with new credit being bought to maintain the duration.

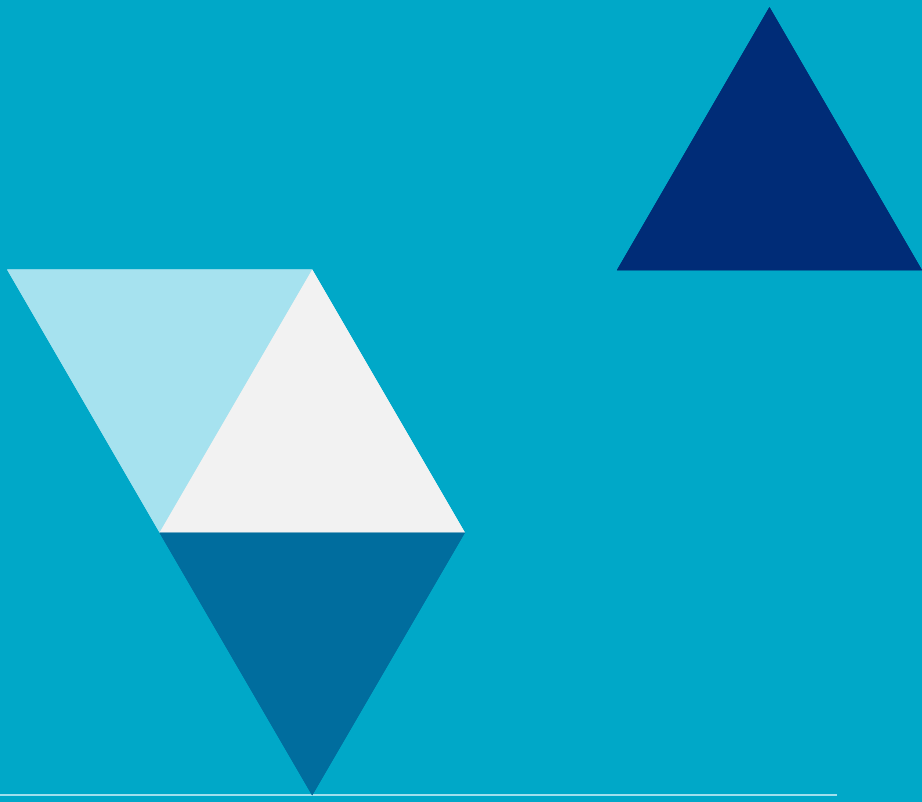
What is the potential impact of cashflow matching and how can we account for it?

- We have modelled a cashflow matching strategy. It is unlikely that cashflow matching can be achieved to a significant extent for non-pensioner liabilities. We would, therefore, expect superfunds to adopt a balance sheet hedge backed by high quality fixed income assets to achieve a positive yield relative to gilts, with excess income reinvested and gilts gradually switched into credit assets as the liabilities unwind. This means the reinvestment risk is in relation to credit spreads over the gilt yield rather than total credit yields.

- This approach is the basis of our modelling.

- It would be possible to have a true buy and hold strategy without the need to repurchase credit and run off the strategy to meet cashflow. This would remove reinvestment risk. However, a true buy and hold portfolio would see the percentage allocation to credit reduce as cashflow is paid out, given the shorter maturity of credit relative to gilts, thereby reducing the discount rate over time.

CONCLUSIONS



KEY CONCLUSIONS

Based on the analysis presented in this report, we draw the following conclusions (which should be tested against the TPR risk tolerance):

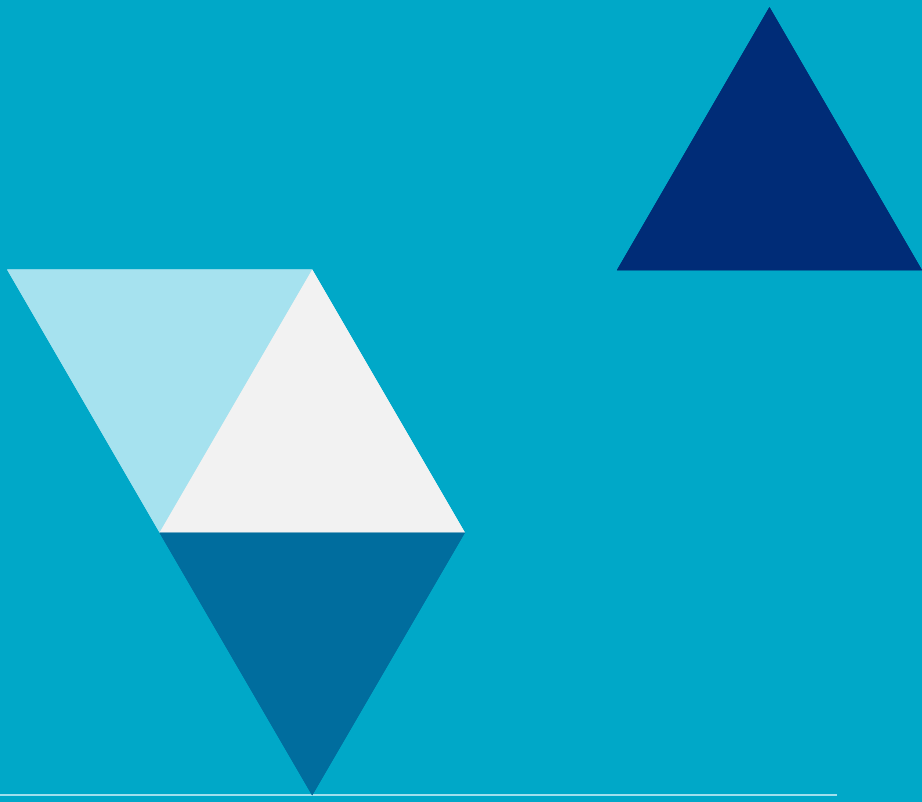
Funding basis	Based on 20 year ALM analysis and POMB analysis, we support a funding basis with a discount rate of gilts + 0.5% pa.
Investment strategy	By increasing the level of diversification in the credit holdings and marginally increasing cashflow matching, the efficiency of the strategy is improved. Strategy B has a higher level of risk than the other strategies and a correspondingly higher level of risk capital would be required.
Initial funding level	For Strategies A & C, we consider a 15% buffer above full funding on the gilts + 0.5% basis to be sufficient. For Strategy B, this should be increased to around 25%. This excludes consideration of longevity risk (see below).
Longevity risk	Longevity risk is likely to be significant for superfunds. We suggest the buffers above are increased by adding 3% to allow for longevity risk. This implies the following: • For Strategies A & C, we consider a 18% buffer above full funding on the gilts + 0.5% basis to be sufficient. • For Strategy B, this should be increased to around 28%.
POMB analysis	We consider the POMB analysis to provide a useful secondary test alongside a solvency-based test focussed on maintaining a 100% funding level, since it provides insight as to whether the initial level of funding is sufficient for a given investment strategy. It is particularly useful in looking at long term strategies. Our analysis shows that all three strategies deliver strong results with POMB statistics in excess of 99% once a suitably calibrated funding buffer has been introduced.

FURTHER CONSIDERATIONS

In addition to the main model-based analysis we have also considered the following aspects:

Consideration of membership development and buyout probability	Under our modelling, in over half of the scenarios buy-out will be achievable within 15 years. By year 25 the vast majority of scenarios where buy-out will be achievable at some point will already have done so. The majority of remaining cases at year 25 will tend to be badly funded and reach the ruin state under this analysis at a later point. In our view, this analysis supports existing conclusions about the levels at which funding buffers should be set.
PPF drift	We have carried out an approximate analysis of PPF drift which shows that the likelihood of a 105% PPF trigger being breached will be lower than that of the 100% funding level trigger being breached for most schemes over a 20 year projection period. The exception is where full scheme benefits are very close to PPF benefits, in which case 105% of PPF liabilities could become higher than 100% of scheme liabilities over time.
Expenses	We recommend that superfunds are required to capitalise the value of expected expenses and include that in the reported funding level and therefore allow for it in the funding buffer.
Investment concentration limits	In addition to the high level investment strategy and the level of buffers appropriate, we recommend that concentration risk is appropriately managed within each asset class and at an overall level in respect of the following: security level, issuer level, industry sector.

APPENDIX



APPENDIX
MODELLING ASSUMPTIONS

Economic model

- Analysis is shown at 30 September 2019.
- Asset-liability modelling projections are over a 20-year period and simulate 10,000 scenarios.

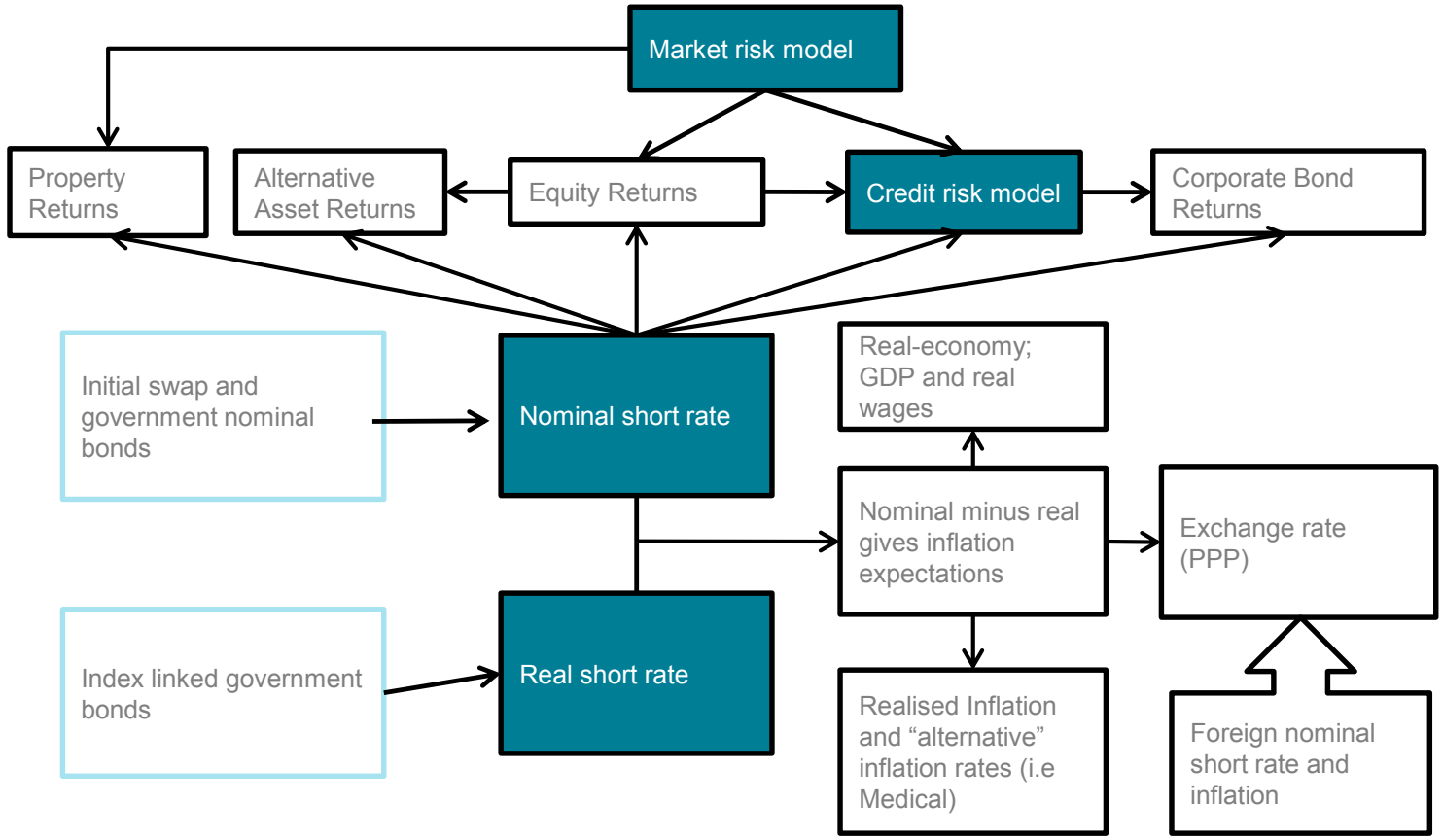
Mercer's UK Capital Market Assumptions

- The table to the right shows summary statistics illustrating the distributions generated by our asset liability models for a 10 year period beginning 30 September 2019. We have also included absolute standard deviation figures for each asset class over 1 year. It is this volatility which drives 1 year value at risk calculations.

Asset Class	30/09/2019			
	Excess return over cash		Absolute	
	Arithmetic Mean	Median	Multi Year Standard deviation	One Year Standard deviation
	(% p.a.)	(% p.a.)	(% p.a.)	(% p.a.)
Fixed interest gilts (>15 years)	0.0	-0.3	8.7	13.1
Index-linked gilts (> 5 years)	-0.3	-0.8	9.0	9.6
Sterling non-gilts (all stocks)	0.9	0.9	3.2	6.9
Sterling non-gilts (>10 years)	0.9	0.7	5.5	10.0
Developed Global Equity (Hedged)	4.5	3.4	16.9	16.2
Emerging Market Equity	6.3	3.1	28.7	25.9
Small Cap Equity (Unhedged)	5.8	4.0	20.4	19.6
Defensive Equity (Hedged)	3.9	3.1	13.6	12.9
Conventional Property	3.0	2.0	14.1	13.9
High Lease Value Property	1.9	1.5	7.7	8.0
Hedge Funds (Standard)	2.3	2.1	7.3	6.6
High Yield Debt (Hedged)	2.3	2.0	9.7	9.7
Emerging Market Debt (LC)	3.8	2.8	13.5	13.3
Emerging Market Debt (HC)	2.4	2.1	8.0	7.9
Infrastructure Unlisted Equity	4.2	3.2	14.7	14.5
Private Debt (Junior)	3.9	3.3	12.2	12.6
Private Debt (Senior)	2.5	2.3	9.0	8.9
Private Equity	6.8	4.1	24.2	23.9
Multi Asset Credit	3.0	3.0	7.8	7.8
Absolute Return Fixed Income	1.5	1.5	4.0	3.0

APPENDIX
RISK BUDGETING TOOL – MODELLING STRUCTURE

- The basic framework of our modelling is shown below.
- The most fundamental elements are the **real and nominal interest rate**, **credit** and **equity** models.
- Other asset returns and economic variables will be driven by these factors (plus asset-specific risks).



APPENDIX
RISK BUDGETING TOOL – KEY NOTES

- Mercer uses a stochastic model for asset/liability modelling. Expected asset class returns, volatilities and correlations are an **output from this model** rather than being directly specified. In calibrating the model, we generally **avoid taking any particular view on future economic conditions**.

- Our starting point is that there is **no nominal interest rate term premium** (i.e. no upward or downward bias of future yields relative to market expectations). In principal the expected returns (over any given holding period) for cash and nominal government bonds of any duration will be approximately the same.

- We also assume a **modest negative term premium** for index-linked government bonds. This means that, on average**, index linked bonds will be expected to underperform fixed interest government bonds.** This is not conditional on a low starting level of real yields.

- Swap rates are modelled using the nominal and real interest rate models, plus a spread component that is calibrated to market gilt-swap spreads. The model allows for **volatility in the gilt-swap spread** (z-spread) over time.

- Our expectations for the credit risk premium are derived from the **initial level of credit spreads** but also take into account default and downgrade risk. We assume **credit spreads will revert to a long-term average level over time**.

- Expected returns for other risky assets are based on expectations for cash returns which in turn are derived from prevailing risk-free rates (government bond curves) and analysis of **medium to long-term historic asset class risk premia**.

- We assume a constant equity risk premium (arithmetic mean) of 4.5% per annum. As a result expected nominal equity returns will be low when risk-free rates are low and vice versa.

- We model alternative asset classes by **linking these to underlying risk drivers** (e.g. equity beta, credit spread) and making adjustments for asset-class specific risk premia and volatility.

- We **do not make any allowance for views on current market valuation** - implicitly, markets are assumed to be fairly valued at the projection date. Our Dynamic Asset Allocation (DAA) service provides our tactical views which can be used as an overlay when determining an asset allocation.

APPENDIX
IMPACT OF COVID 19 CRISIS

- We have continued to use our capital market assumptions and simulations based on conditions as at 30 September 2019. We consider this to be reasonable; since they are long term in nature and the conclusions apply to events which will / may occur in the future meaning no particular date represents the relevant conditions.
- We have not therefore updated our assumptions to allow for the impact of the COVID-19 crisis. We consider that to be reasonable for the reasons set out below. The key changes to our simulation set as at 30 April 2020 are as follows:
    - **Credit spreads have widened** and this flows through to higher returns as the additional yield more than offset increased downgrades and defaults.
    - **Short term equity volatility are heightened** before reverting to long term level after 2 -3 years.
    - The **equity risk premium** remained unchanged at a mean value of 4.5% relative to risk free cash.
    - **Depressed nominal yields** reduces the value on liability hedging on average although again this is likely to be marginal.
- For ongoing schemes in general, Q1 caused a deterioration in funding and so less chance of positive outcomes including a reduction in POMB. However, if we were to start the projection at the same funding level (e.g. still use 100% 115%, 120% as the starting point) then we would expect the outcomes to be marginally improved due to increased risk premia particularly on credit.
- Clearly this “opportunity” may not persist.
- In the shorter term we consider volatility to be elevated by the COVID-19 crisis. While we don’t expect this to have a material impact on longer term projections, it will have some impact.
- Overall we would expect projections (from the same starting funding level) to be marginally improved, but with the main conclusions retained.

APPENDIX
RISK BUDGETING TOOL – LONGEVITY MODELLING

- Liability cashflows can have a **specific** longevity tracking error assigned, defined in terms of a distribution type (typically lognormal), mean and volatility.
- Volatility parameters can be **tenor dependent** (i.e. longer duration cashflows have a higher level of longevity risk than earlier duration). As such a longevity event (such as a large increase to life expectancies) will have a **proportionally higher impact on longer term cashflows** than those that are to be paid soon.
- Longevity risk is **independent** of all other risk factors in the our economic scenarios (interest rates, inflation, credit, growth assets, etc).
- Longevity risk is typically used in the context of:
  - Short term risk (for example, contribution to **1 year VaR 99% VaR**), or
  - Long term risk (for example measuring **impact on funding outcomes**, over 10+ years)

APPENDIX
RISK BUDGETING TOOL – LIMITATIONS

- **Models are approximations of reality and no model is perfect**.

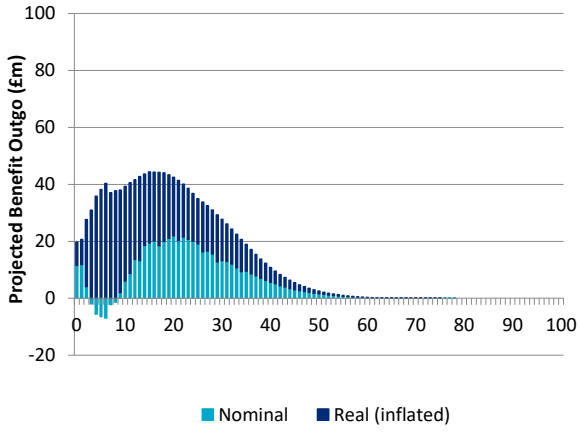
- When building a model, compromises need to be made between simplicity and usability. In setting our underlying assumptions and calibrating models, decisions need to be made about a range of factors:
  - How much weight should be given to recent levels of market volatility compared to long-term historic averages?
  - Should future volatility levels be determined by the markets, through observation of derivative prices?
  - When considering expected asset class returns, should history be the guide (e.g. what has the equity risk premium been in the past?) or should we attempt to determine expected returns from first principles (e.g. build up equity returns based on prevailing dividend yields and economic growth forecasts)?

- We do not know what is going to happen in the future and the output from any model should be viewed with this in mind. We do not make any spurious claims to accuracy and we acknowledge that there are a wide range of alternative underlying assumptions that may be just as valid as those we use.

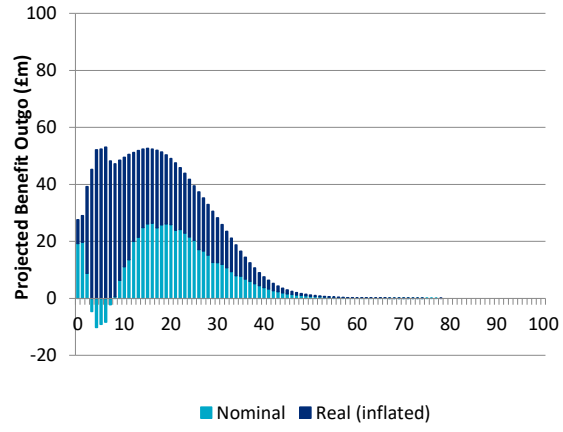
APPENDIX
CASHFLOW PROFILES

- The charts below illustrate the proposed cashflow profile used within the asset-liability modelling analysis, split by nominal and real cashflows. The pensioner proportions under the profiles are 50%, 80% and 20% (from left to right).
- The demographic assumptions underlying these profiles are set out in the table below.

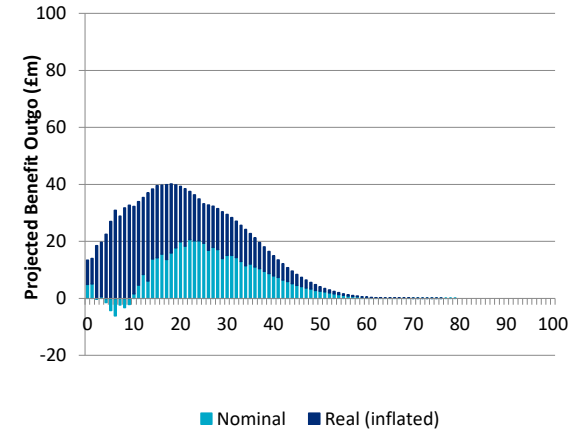
CASHFLOW PROFILE 1
50% PENSIONERS/ 50% DEFERREDS



CASHFLOW PROFILE 2
80% PENSIONERS/ 20% DEFERREDS



CASHFLOW PROFILE 3
20% PENSIONERS/ 80% DEFERREDS

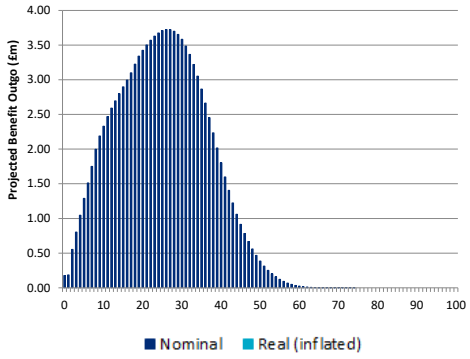


Assumptions	
Commutation	We have assumed that 20% of the total value being a lump sum is equivalent to c. 25% of a member's pension being commuted (spouse's pension is not commutable and this is estimated to be c. 20% of total value).
Proportion married	85%
Spouse's fraction	50%
Expenses	We have assumed an allowance for expenses is capitalized into the liability value and expenses are proportional to benefit cashflow.

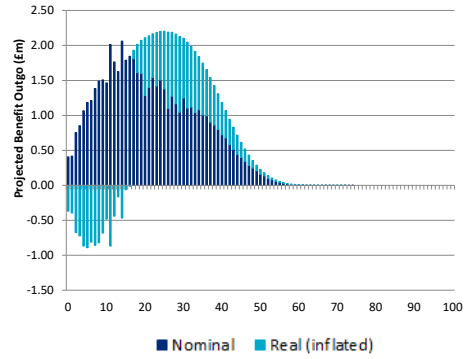
APPENDIX
CASHFLOW PROFILES

The charts below show the underlying benefit tranches for deferreds and pensioners:

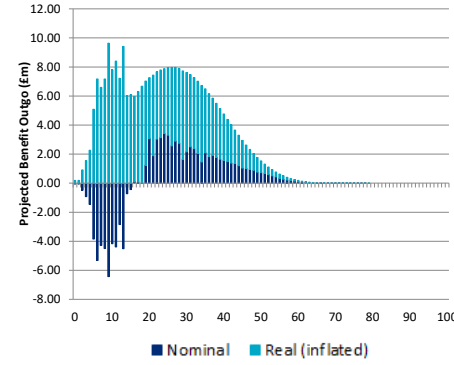
DEFERREDS: FIXED



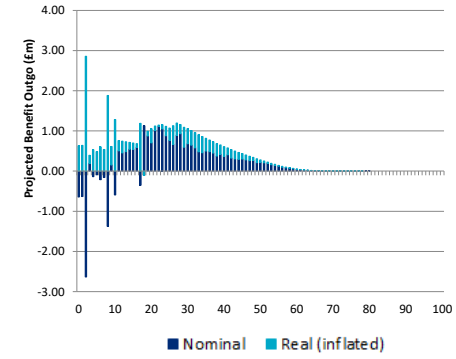
DEFERREDS: FIXED – CPI (0,3)



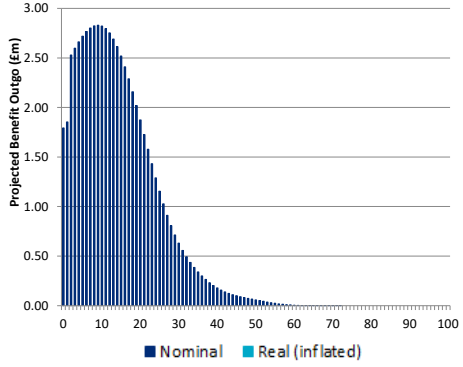
DEFERREDS: CPI (0,5) – RPI (0,5)



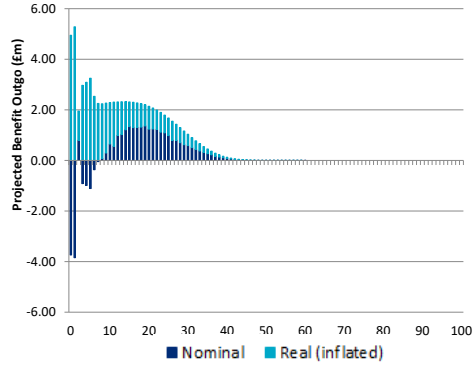
DEFERREDS: CPI (0,2.5) – RPI (0,2.5)



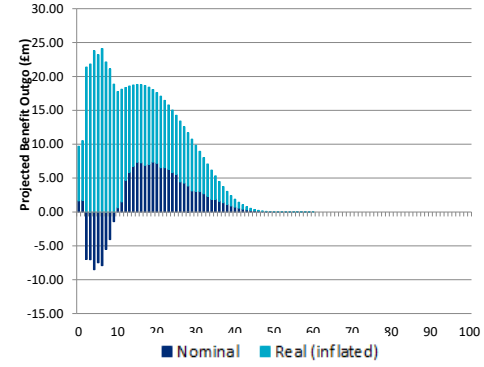
PENSIONERS: FIXED



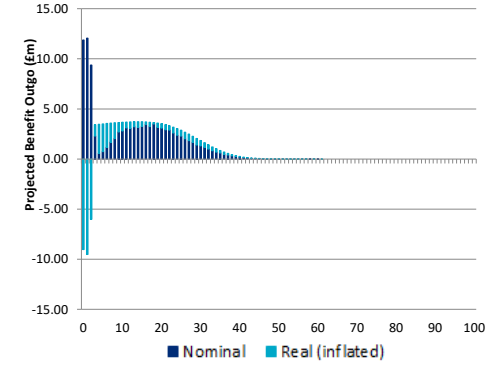
PENSIONERS: CPI (0,3)



PENSIONERS: RPI 90,5)



DEFERREDS: CPI (0,5) – RPI 90,5)



APPENDIX
DURATION TARGETS

Cashflow Profile*	Duration (years) (Funding / Buyout)	Inflation Proportion
80% Pensioners 20% Deferreds	16.1 / 17.0	54%
50% Pensioners 50% Deferreds	17.8 / 19.0	54%
20% Pensioners 80% Deferreds	20.0 / 21.4	53%

APPENDIX
LIABILITY BASES

The table below shows the main assumptions that are used in calculating the valuation liabilities.

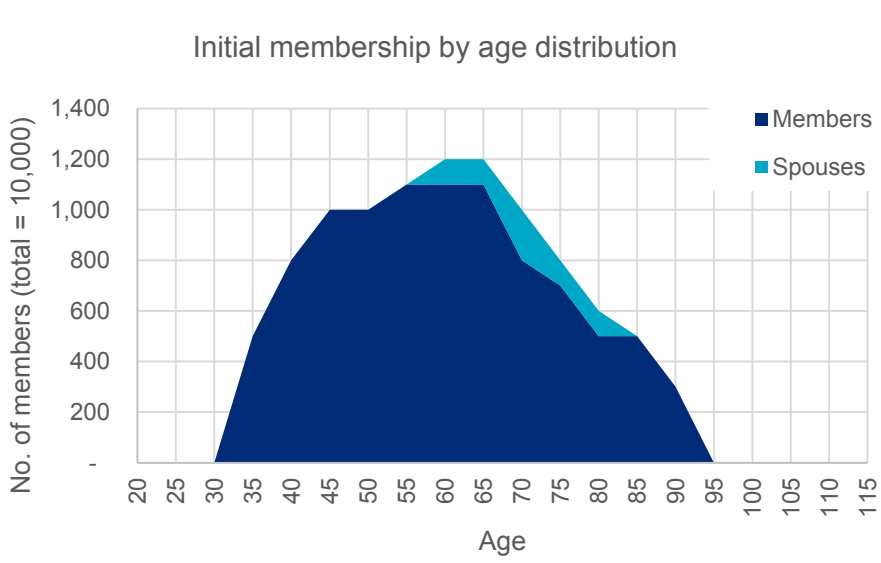
Assumptions	Funding basis
Pre and post retirement discount rate	Gilts + 0.5% p.a.
Pension increases	Assumptions derived in line with best-estimate assumptions
Mortality	• Pensioners: 100% of S2PA, CMI2018 Core parameters, LTR 1.75% • Deferreds: 100% of S2PA, CMI2018 Core parameters, LTR 1.75%
RPI – CPI wedge	• 1% p.a. • Realised CPI is modelled as a deterministic variable
Mortality risk	Not modelled within the 20 year ALM projections, but allowed for under the longer-term POMB projections
Mortality age rating	0 years
Mortality weighting	100% for males and females
Guarantee	5 years
RPI	Assumption derived in line with best-estimate, with no IRP
Spouse's age	Females are assumed to be 3 years younger than males
Membership profile gender	60% of liabilities are associated with males and 40% with females

APPENDIX
MODELLING THEORY BEHIND BUY OUT PROBABILITIES AND MEMBERSHIP DEVELOPMENT

Buy out basis modelling

- We discounted the pensioner cashflows on gilts + 0.2% p.a. throughout the modelling. Other assumptions were in line with the funding basis.
- Initially deferred cashflows were discounted on gilts - 0.5% p.a.. Over 30 years this margin was moved linearly to gilts + 0.2% p.a. to represent the natural maturing of the profile and increased attractiveness to insurers. Other assumptions were in line with the funding basis.
- In our charts we have highlighted simulations where the funding level is in a corridor between 95% and 100% as we see this as a position in which buy-out is possible if not necessarily likely.

Membership Development



Commentary

The chart on the left illustrates the initial membership profile we have assumed. Clearly this is highly specific to particular schemes.

We have projected this forwards allowing for mortality based on the following table

- 100% of S2PA, CMI2018 Core parameters, LTR 1.75%

The development of spouses is based on an assumption of 85% of member being married (this proportion reduces in line with mortality assumptions for older members).

For simplicity we have not allowed for an age difference between spouses and members or considered future improvements in mortality in detail.

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