This presentation is addressed to London Borough of Barnet as Administering Authority to the London Borough of Barnet Pension Fund and **must not be shared with any third party.**

London Borough of Barnet Pension Fund

2022 valuation - climate risk analysis

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Addressee and Purpose

- This paper has been requested by, and is addressed to, the London Borough of Barnet in its capacity as Administering Authority to the London Borough of Barnet Pension Fund ("the Fund").
- The purpose of this paper is to carry out a review of the 2022 valuation funding strategy, for the Whole Fund, to ensure this remains sufficiently resilient to three specific climate change scenarios.
- This paper should not be disclosed to any third parties (including the Employers or their advisers). We accept no liability to third parties and/or for any other purpose than above, unless expressly accepted in writing.

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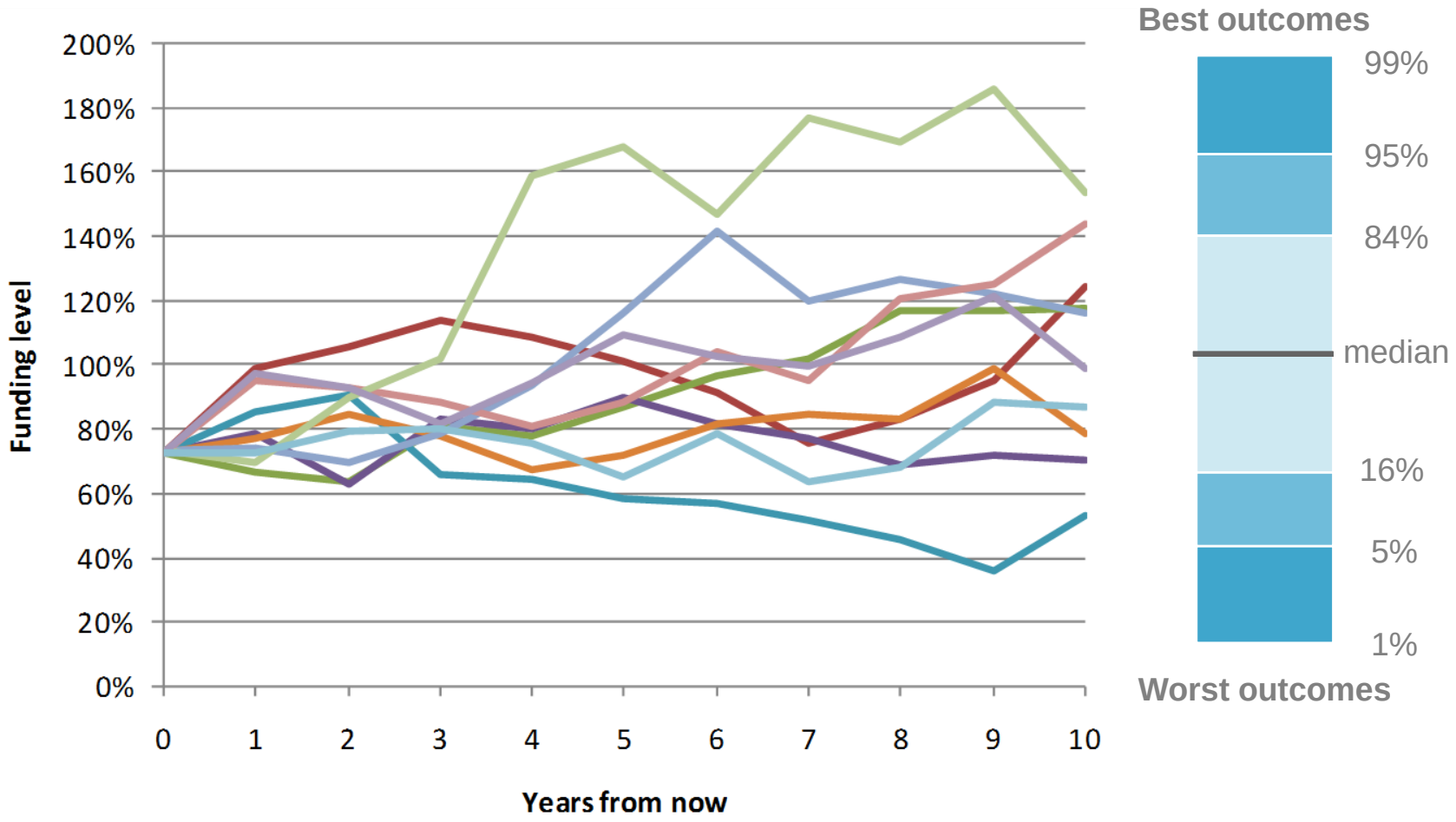
Methodology

Methodology

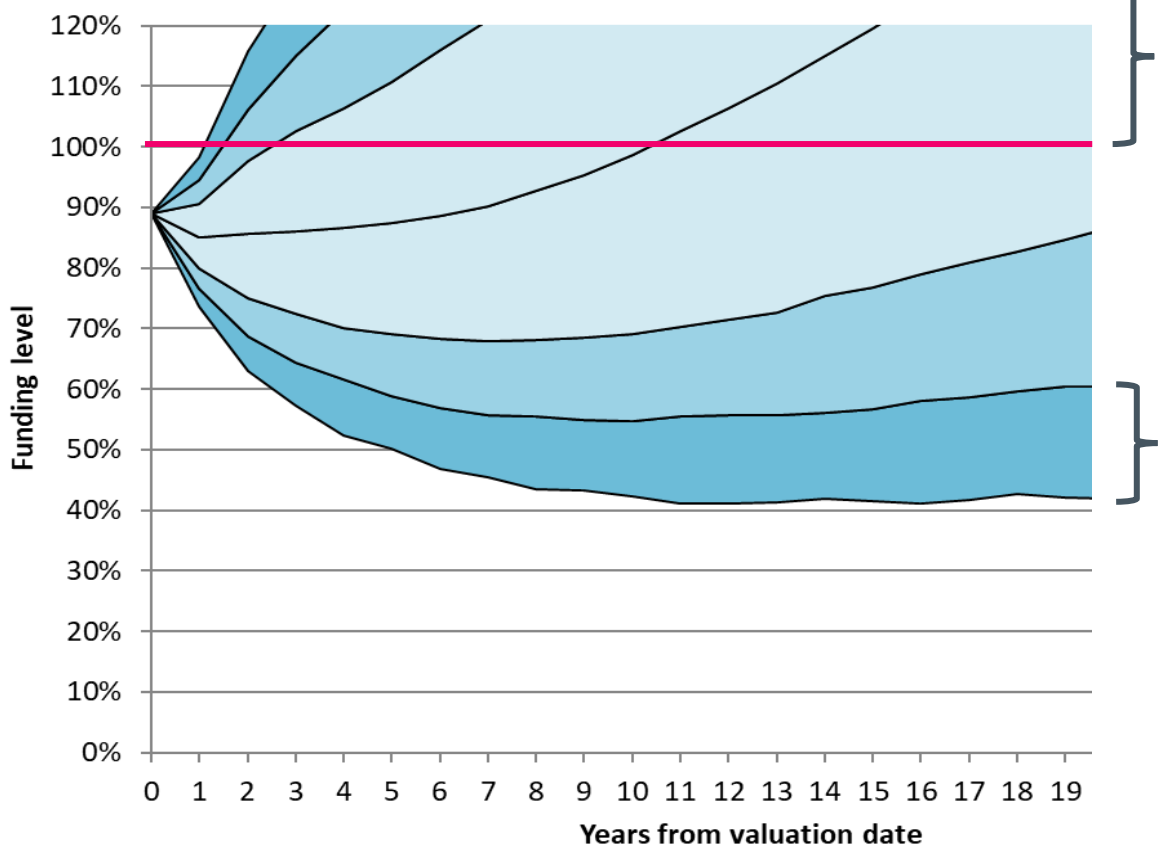
- This modelling is a form of asset-liability modelling (“ALM”).
- Assets and liabilities are projected forward from 31 March 2022 under 5,000 different outcomes for future market and economic conditions. See “Reliances, limitations and additional details” appendix for details of the expected return on assets, economic conditions and the associated volatilities.
- For each outcome (5,000 per scenario), we calculate the funding position annually throughout the projection period.
- The funding position uses the same methodology as at the 2022 formal valuation.
- We then rank the 5,000 outcomes from best to worst and we plot the outcomes graphically (as shown in the following two pages).
- We can then compare the range of outcomes with other scenarios.
- Please note the following likelihoods are adopted for each graph (please see the key on the following page for further details)
    - Lightest coloured ranges represent middle 2/3rds of the outcomes
    - The range above and below this shows 1 in 6 outcomes each
    - This range is further split into 1 in 10 for the next lightest range and 1 in 20 for the darkest range of outcomes
    - The best and worst 1% of outcomes are not shown on the graphs

5,000 scenarios gives an outcome distribution



Understand future volatility and, most importantly, upside and downside risk in a particular funding strategy

Approach to reviewing strategies



Likelihood of success: how many of the 5,000 scenarios achieve the funding target at the end of the time horizon

Downside risk: the average of the worst 5% of funding outcomes at the end of the time horizon

Compare and contrast the outcomes (risk measures) for different contribution and investment strategies

Model inputs: liabilities and assets

Liabilities

- Liability values are calculated using the membership data provided as at 31 March 2022 by the Fund, and the same methodology as the 2022 valuation
- The assumptions used for the funding position summary on the following page are shown here in Table 1.
- All future liability values are calculated using the ongoing funding target which uses the financial and demographic assumptions agreed for the 2022 valuation (Table 2).

Table 1 – 2022 valuation funding position assumptions

% p.a.	31 March 2022
Discount rate	4.6%
Salary increases	3.7%
Pension increases	2.7%

Table 2 – 2022 valuation future liability assumptions

	Funding target assumption
Discount rate	2.8% above risk free market rate
Salary increases	Consumer Price Index Inflation plus 1.0%
Pension increases	Consumer Price Index inflation

Assets

- Assets are projected based on the asset value as at 31 March 2022, and contributions expected from then, as per the Rates and Adjustments certificate dated March 2023.

Assets and liabilities are valued consistently

Model inputs: investment strategies

- For the purpose of exploring the climate risk scenarios in this modelling, we have applied the current investment strategy
- The table details the asset allocations of the investment strategy we have modelled.

	Allocation
Global equities	40.0%
Private equity	5.0%
Emerging Market Equities	5.0%
Infrastructure equity	8.0%
Corporate bonds	10.0%
Asset backed securities	6.0%
Property	6.0%
Multi Asset Credit	7.0%
Private Lending	13.0%
Grand total	**100.0%**

Exploring the impact of climate change risk

- Climate change is too uncertain to “build in” to our model directly like we do with e.g. inflation risk
- Instead we see how the results change if we stress the model in three different scenarios
  - Given it is a stress test, all three scenarios are “bad”
  - Consider all three scenarios to understand the strategy’s resilience
- Purpose is to test resilience, not re-run all the previous analysis

Climate scenarios give us extra information to help make our decision, they don’t replace existing modelling results

Testing “resilience” (TCFD requirement)

What could this mean?

- Does the chosen strategy still meet the chosen targets under all scenarios?
- Does it miss them by an acceptable margin (they are stress tests after all)?
- Does it satisfy other risk measures (e.g. short term downside risk)?
- Is it still the ‘best’ option even when compared against other options under the climate scenarios?

Use your judgement when deciding how to test resilience

Our scenarios are based on the speed and strength of the response to climate change

Green revolution

- Concerted policy action starting now e.g. carbon pricing, green subsidies
- Public and private spending on “green solutions”
- Improved disclosures encourage market prices to shift quickly
- Transition risks in the short term, but less physical risk in the long term
- High expectation of achieving <2°C

Delayed transition

- No significant action in the short-term, meaning response must be stronger when it does happen
- Shorter and sharper period of transition
- Greater (but delayed) transition risks but similar physical risks in the long term
- High expectation of achieving <2°C

Head in the sand

- No or little policy action for many years
- Growing fears over ultimate consequences leads to market uncertainty and price adjustments
- Ineffective and piecemeal action increases uncertainty
- Transition risks exceeded by physical risks
- Low/no expectation of achieving <2°C

All three scenarios are ‘difficult’ so we are stress testing the base

In each scenario we assume a disruptive period of high volatility

Our scenarios assume that

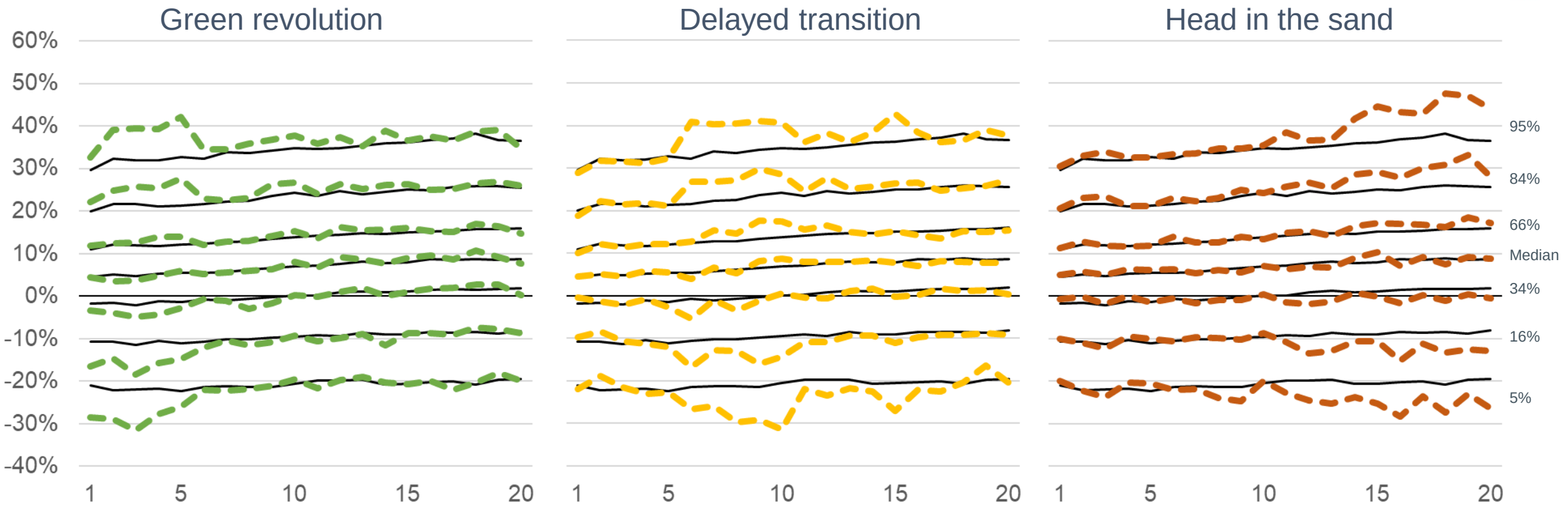
- There will be a period of disruption linked either to the response to climate risk (transition risks) or the effects of it (physical risks)
- This disruption will lead to high volatility in financial markets
- The later the period of disruption, the more pronounced it will be

Scenario	Volatility criteria			
	Years 1-5	Years 6-10	Years 11-15	Years 16-20
Green revolution	Very high	Moderate	Moderate	
Delayed transition		Very high	High	
Head in the sand			High	Very high

We use volatility criteria to "tilt" the modelling results towards simulations with higher volatility in the periods in question

Volatility criteria: Moderate = 60th percentile, High = 75th percentile, Very high = 85th percentile

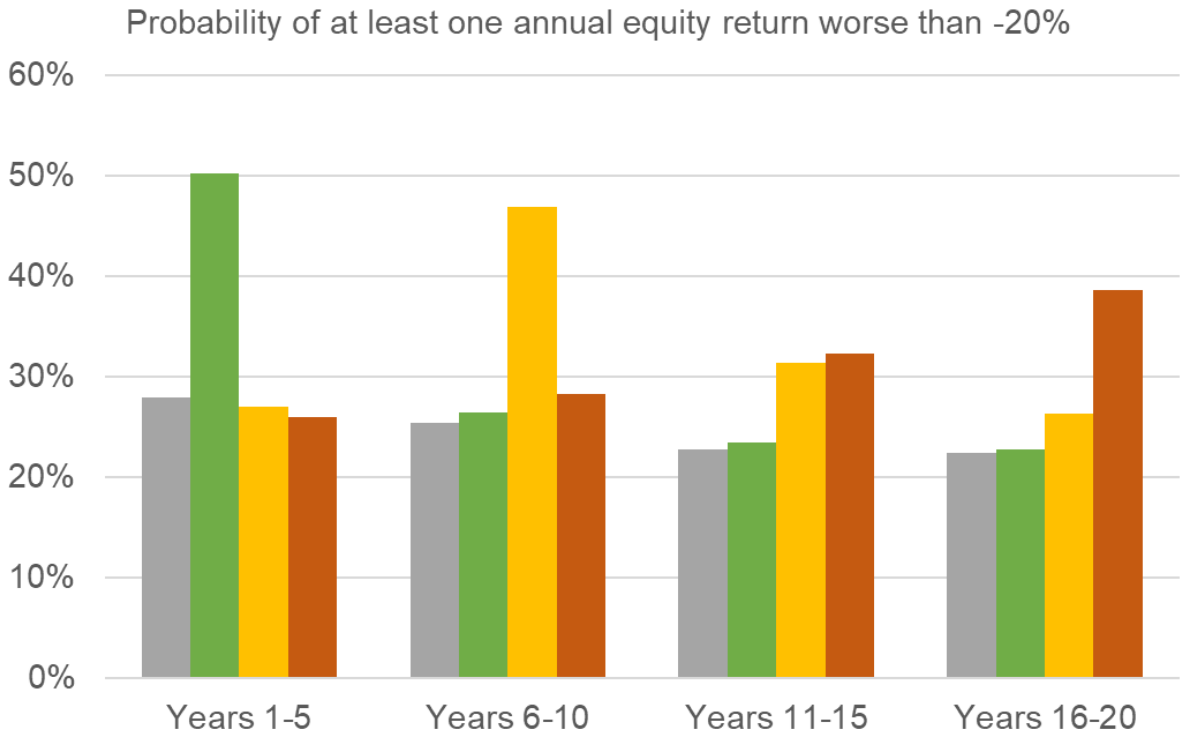
Example of scenario impact (global equity returns)

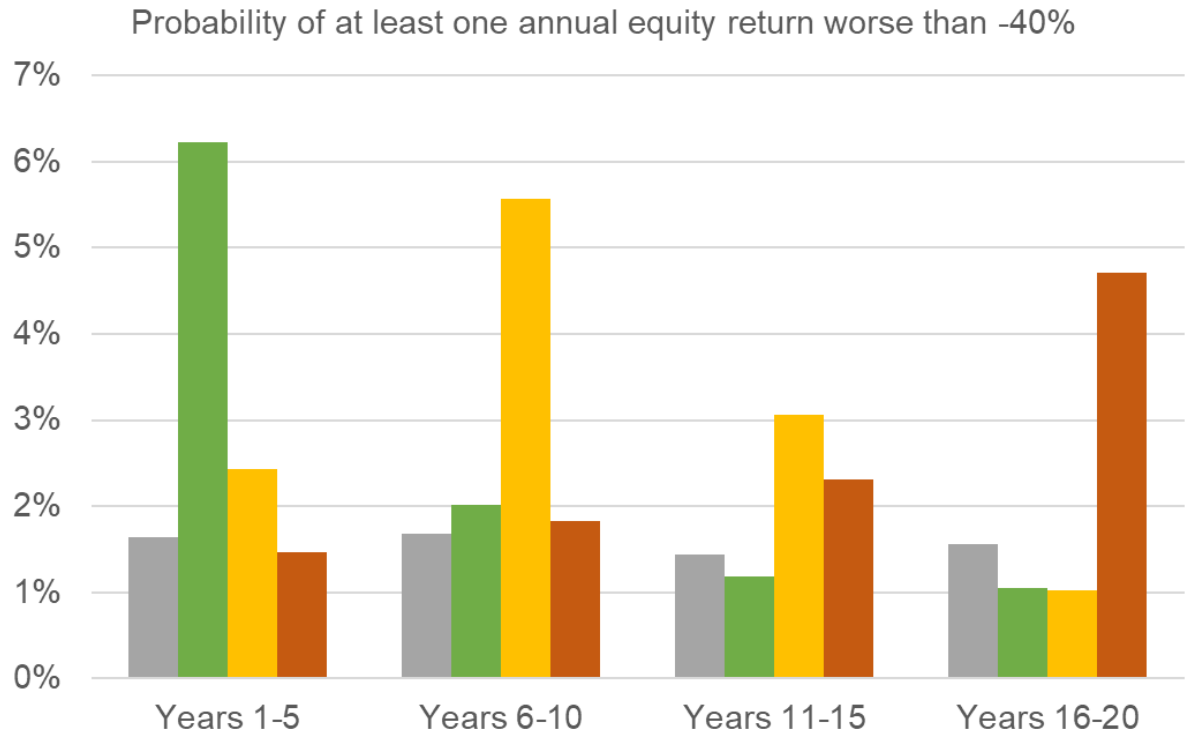


Scenario views widen the distribution of key variables in different time periods

Solid black lines are the unweighted base case

Example of scenario impact (equity shock)





Increased volatility gives a much higher chance of significant equity shocks

Bars from left to right: Unweighted base case (grey), Green revolution, Delayed transition, Head in the sand

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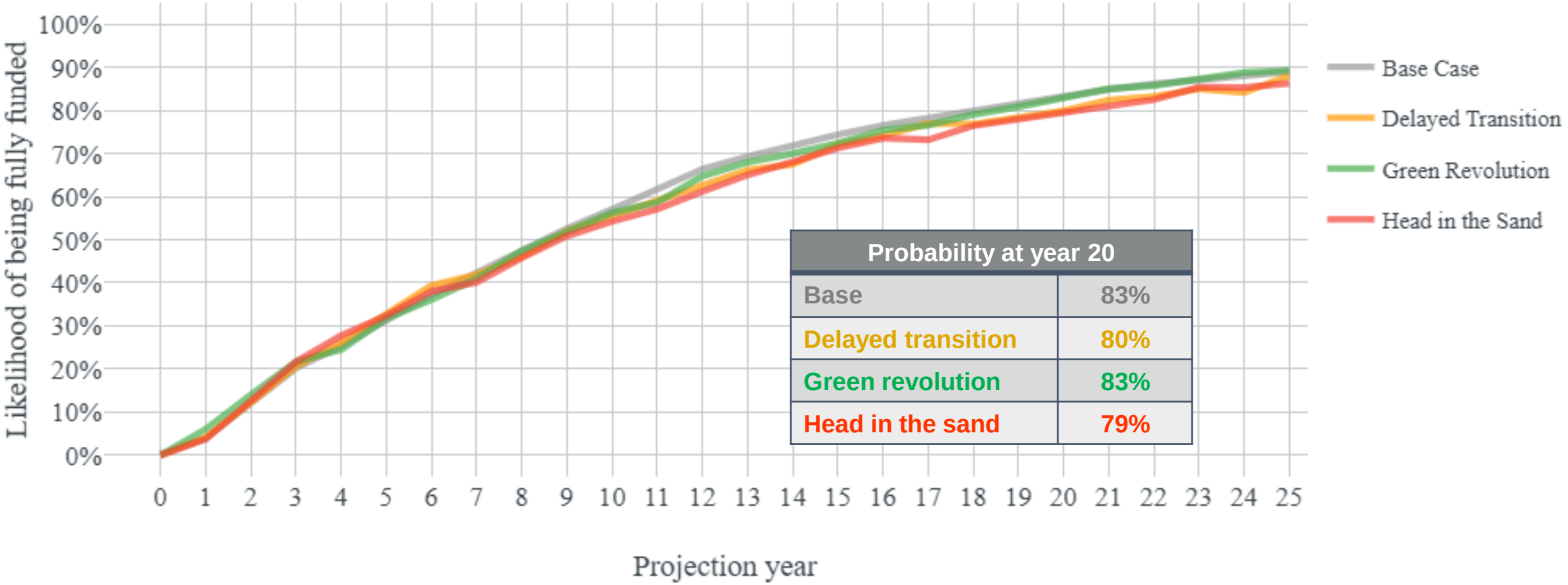
Results

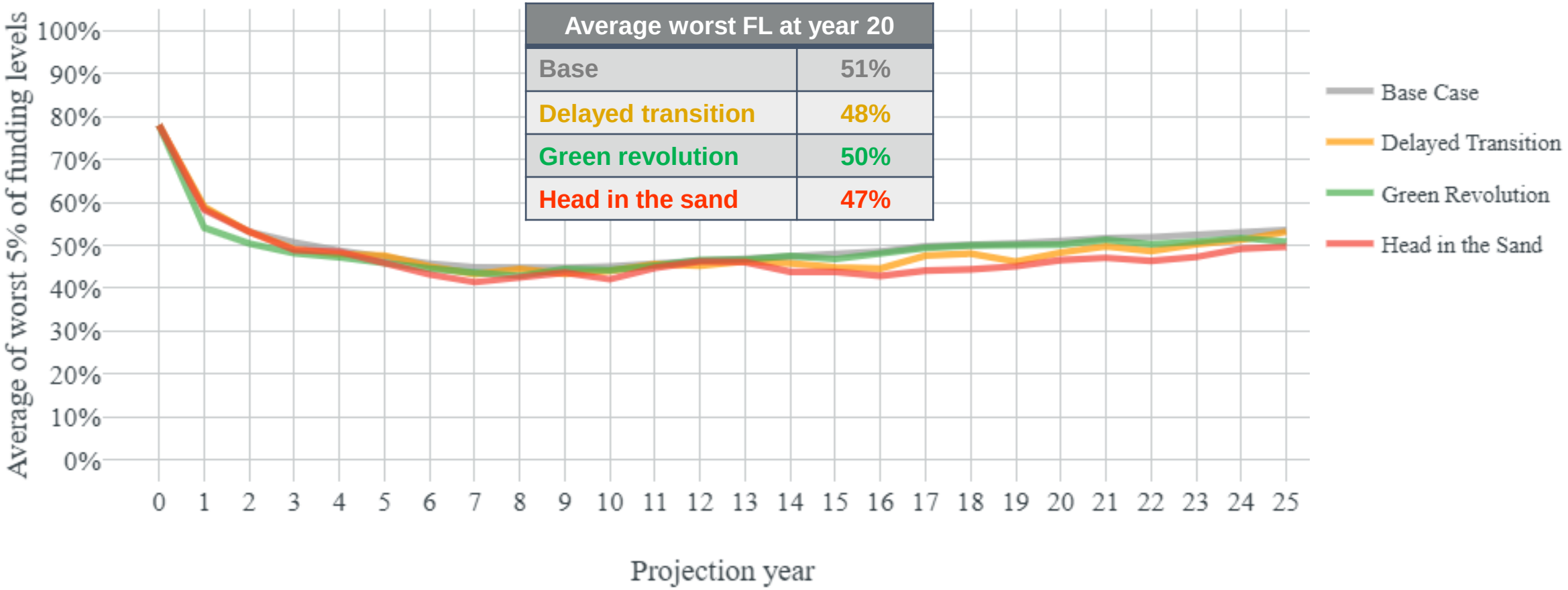
Results: Probability of full funding



Probability at year 20	
Base	83%
Delayed transition	80%
Green revolution	83%
Head in the sand	79%

Results: Downside risk metric

Average worst FL at year 20	
Base	51%
Delayed transition	48%
Green revolution	50%
Head in the sand	47%



Absolute starting point of funding level should be ignored, focus of this analysis is on relative differences

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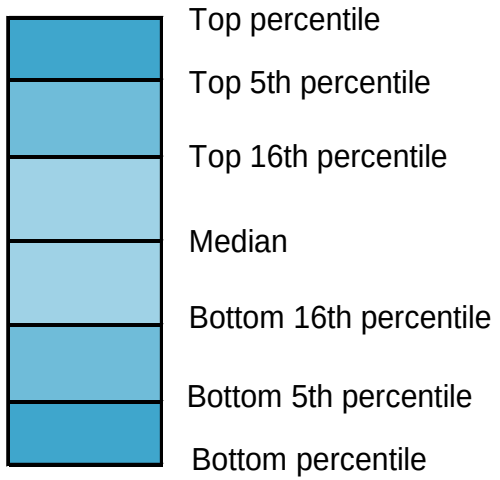
Appendix - Technical & Professional Notes

Reliances, limitations and additional details (1)

- We undertake 5,000 simulations of the future for each scenario. The outcomes of the simulations are ranked from “best” to “worst”. The spread of outcomes at a given point in time for a given strategy can be illustrated in charts as follows.
- The “median” funding level can be considered to be the average outcome. It should be noted that this is not the same as saying this is the most likely outcome, rather it represents the value with which we would expect all outcomes to have a 50% chance of being above and a 50% chance of being below.
- The bottom 16th percentile – approximately 1 outcome in 6 is worse than this level.
- The top 16th percentile – approximately 5 outcomes in 6 would be expected to be below this level.



- The bottom 5th percentile can be considered a “bad” outcome – 1 outcome in 20 of the simulations is expected to be worse than this.
- The top 5th percentile can be considered a “good” outcome – 19 outcomes in 20 of the simulations are expected to be below this level.
- The bottom percentile can be considered an “extremely bad” outcome, which occurs with a probability of 1 in 100.
- The top percentile can be considered an “extremely good” outcome, which occurs with a probability of 1 in 100.
- When plotting the distribution of contribution rates, rather than funding levels, the description of any outcome as ‘bad’ or ‘good’ is reversed.
- In all the charts we consider, there will be some outcomes above and below the highest and lowest levels shown.

Reliances, limitations and additional details (2)

Data – ESS

The distributions of outcomes depend significantly on the Economic Scenario Service (ESS), our (proprietary) stochastic asset model. This type of model is known as an economic scenario generator and uses probability distributions to project a range of possible outcomes for the future behaviour of asset returns and economic variables. Some of the parameters of the model are dependent on the current state of financial markets and are updated each month (for example, the current level of equity market volatility) while other more subjective parameters do not change with different calibrations of the model.

Key subjective assumptions are the average excess equity return over the risk free asset (tending to approximately 3% p.a. as the investment horizon is increased), the volatility of equity returns (approximately 18% p.a. over the long term) and the level and volatility of yields, credit spreads, inflation and expected (breakeven) inflation, which affect the projected value placed on the liabilities and bond returns. The market for CPI linked instruments is not well developed and our model for expected CPI in particular may be subject to additional model uncertainty as a consequence. The output of the model is also affected by other more subtle effects, such as the correlations between economic and financial variables.

Our expectation (i.e. the average outcome) is that long term real interest rates will gradually rise from their current low levels. Higher long-term yields in the future will mean a lower value placed on liabilities and therefore our median projection will show, all other things being equal, an improvement in the current funding position (because of the mismatch between assets and liabilities). The mean reversion in yields also affects expected bond returns.

While the model allows for the possibility of scenarios that would be extreme by historical standards, including very significant downturns in equity markets, large systemic and structural dislocations are not captured by the model. Such events are unknowable in effect, magnitude and nature, meaning that the most extreme possibilities are not necessarily captured within the distributions of results.

Reliances, limitations and additional details (3)

Given the context of this modelling, we have not undertaken any sensitivity analysis to assess how different the results might be with alternative calibrations of the economic scenario generator, or allowances for resource & environment constraints.

We would be happy to provide fuller information about the scenario generator, and the sensitivities of the results to some of the parameters, on request.

Model

Except where stated, we do not allow for any variation in actual experience away from the demographic assumptions underlying the cash flows. Variations in demographic assumptions (and experience relative to those assumptions) can result in significant changes to the funding level and contribution rates. We allow for variations in inflation (RPI or CPI as appropriate), inflation expectations (RPI or CPI as appropriate), interest rates and asset class returns. Cash flows into and out of the Scheme are projected forward in annual increments, are assumed to occur in the middle of each Scheme year and do not allow for inflation lags. Investment strategies are assumed to be rebalanced annually.

Unless stated otherwise, we have assumed that all contributions are made and not varied throughout the period of projection irrespective of the funding position. In practice the contributions are likely to vary especially if the funding level changes significantly.

Investment strategy is also likely to change with significant changes in funding level, but unless stated otherwise we have not considered the impact of this.

The returns that could be achieved by investing in any of the asset classes will depend on the exact timing of any investment/disinvestment. In addition, there will be costs associated with buying or selling these assets. The model implicitly assumes that all returns are net of costs and that investment/disinvestment and rebalancing are achieved without market impact and without any attempt to 'time' entry or exit.

For the purposes of modelling very low investment risk strategies or matched bond portfolios, we have constructed an LBP (liability benchmark portfolio) that is a hypothetical portfolio that exactly matches the changes in value and cash flows of the liabilities (with a particular allowance for accrual) under all states of the world. It is generally not possible in practice to construct a portfolio with the same high quality of matching as the LBP but major financial and investment risks can be broadly quantified. However, a more detailed analysis is required to understand fully the implications and appropriate implementation of a very low risk or ‘cash flow matched’ strategy.

Reliances, limitations and additional details (4)

Assumptions

We have estimated future service benefit cash flows and projected salary roll for new entrants after the valuation date such that payroll remains constant in real terms (i.e. full replacement). There is a distribution of new entrants introduced at ages between 25 and 65, and the average age of the new entrants is assumed to be 40 years. All new entrants are assumed to join and then leave service at SPA, which is a much simplified set of assumptions compared with the modelling of existing members. The base mortality table used for the new entrants is an average of mortality across the LGPS and is not client specific, which is another simplification compared to the modelling of existing members. Nonetheless, we believe that these assumptions are reasonable for the purposes of the modelling given the highly significant uncertainty associated with the level of new entrants.

There are a number of different types of increases applied before and after retirement to benefits payable from the Fund. A judgement always has to be made as the most appropriate assets from the ESS to model the strategy under consideration. We have agreed this with yourselves during the scoping stage and further details are in the appendices.

TAS Compliance

The models used to carry out this modelling, and this presentation, comply with Technical Actuarial Standards 100 (Principles for Technical Actuarial Work) and 300 (Pensions).

Reliances, limitations and additional details (5)

31 March 2022 ESS calibration summary:

The ESS is calibrated every month with updated current market expectations (a minor calibration). Every so often (annually at most), the ESS is updated to reflect any changes in the fundamental economic parameters as a result of change in macro-level long-term expectations (a major calibration). The following table shows the calibration at 31 March 2022.

		Annualised total returns																		
		Cash	Index Linked Gilts (medium)	Fixed Interest Gilts (medium)	Developed World ex UK Equity	Private Equity	Property	Emerging Markets Equity	Unlisted Infrastructure Equity	Multi Asset Credit (sub inv grade)	Asset Backed Securities (AA rated) GBP	Asset Backed Securities (BBB rated) GBP	Direct Lending (private debt) GBP Hedged	Corp Short A	CorpMedium A	CorpShort BBB	CorpMedium BBB	Inflation (RPI)	Inflation (CPI)	17 year real yield (CPI)	17 year yield
10 years	16th %'ile	0.8%	-1.9%	-0.3%	-0.7%	-1.2%	-0.6%	-2.5%	0.7%	1.7%	1.1%	1.3%	2.7%	1.4%	-0.1%	1.3%	0.0%	2.4%	1.6%	-1.7%	1.1%
	50th %'ile	1.8%	0.2%	1.1%	5.6%	9.4%	4.4%	5.8%	5.9%	3.5%	2.3%	2.9%	6.0%	2.4%	1.6%	2.7%	1.9%	4.1%	3.3%	-0.5%	2.5%
	84th %'ile	2.9%	2.4%	2.4%	11.7%	20.1%	9.5%	14.4%	11.2%	5.2%	3.6%	4.5%	9.2%	3.4%	3.2%	3.9%	3.6%	5.7%	4.9%	0.7%	4.3%
20 years	16th %'ile	1.0%	-1.5%	0.7%	1.5%	2.4%	1.4%	0.1%	2.6%	2.8%	1.5%	1.9%	4.3%	2.0%	1.1%	2.2%	1.3%	1.6%	1.2%	-0.7%	1.3%
	50th %'ile	2.4%	0.1%	1.5%	6.1%	10.0%	5.0%	6.3%	6.5%	4.4%	3.0%	3.5%	6.8%	3.2%	2.1%	3.5%	2.5%	3.1%	2.7%	1.1%	3.2%
	84th %'ile	4.0%	1.9%	2.2%	10.8%	17.6%	8.9%	12.8%	10.6%	6.0%	4.7%	5.4%	9.2%	4.6%	3.2%	5.0%	3.6%	4.7%	4.3%	2.7%	5.7%
40 years	16th %'ile	1.2%	-0.3%	1.5%	3.1%	4.7%	2.6%	2.1%	3.9%	3.6%	1.8%	2.3%	5.5%	2.4%	2.0%	2.6%	2.3%	1.1%	0.9%	-0.6%	1.1%
	50th %'ile	2.9%	1.2%	2.3%	6.5%	10.3%	5.5%	6.8%	7.0%	5.3%	3.5%	4.0%	7.7%	3.9%	3.1%	4.2%	3.4%	2.4%	2.2%	1.3%	3.3%
	84th %'ile	4.9%	3.1%	3.5%	10.2%	16.1%	8.8%	11.7%	10.3%	7.1%	5.6%	6.3%	10.0%	5.8%	4.4%	6.2%	4.9%	3.9%	3.7%	3.2%	6.1%
	Volatility (Disp) (5 yr)	2%	7%	6%	19%	30%	15%	26%	15%	6%	3%	4%	10%	3%	7%	4%	7%	3%	3%		

This calibration of the model indicates that a period of outward yield movement is expected. For example, over the next 20 years our model expects the 17 year maturity annualised real (nominal) interest rate to rise from -2.2% (1.9%) to 1.0% (3.2%).

General risk warning

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