Meeting with Imperial College on aspects of the 2017 Actuarial Valuation of USS

23 November 2017

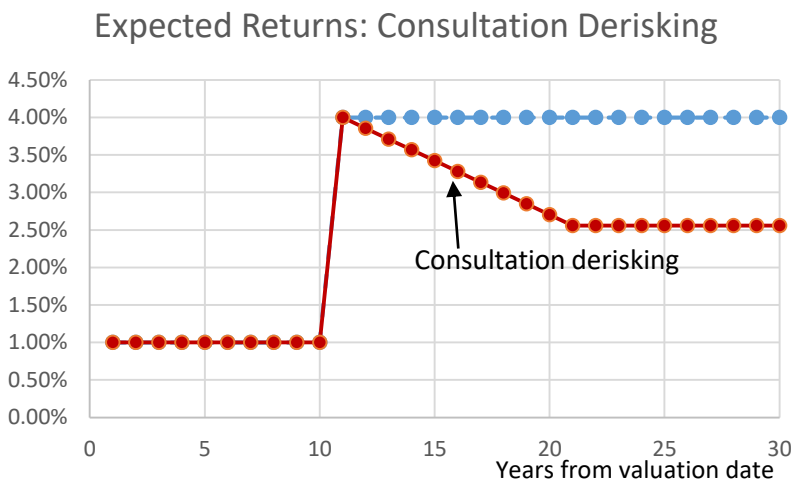
UNIVERSITIES SUPERANNUATION SCHEME LTD

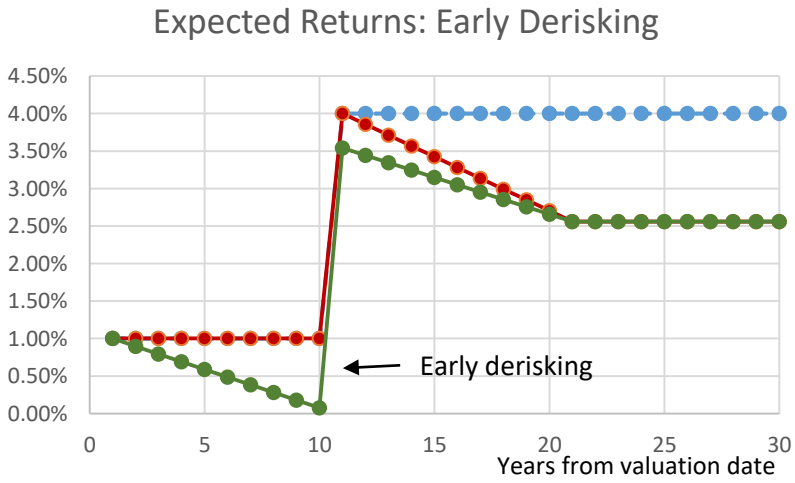
Agenda

1. Introductions
2. Objectives and scope of the meeting
3. Background
   - Context
   - Transparency, consultation, TAS
4. Discussion Point 1: The planned derisking strategy
   - Section 2.1 of IWP document
5. Discussion Point 2: Methodology, inputs and outputs – transparency questions
   - Section 2.2 of IWP document.
   - Section 2.3 (part) of IWP document. Specifically points 1, 2, 3, 4
6. Discussion Point 3: Clarification by Ortec on the model and technical papers
   - Section 2.3 (part) of IWP document. Specifically point 5
   - Section 2.4 of IWP document
7. Wrap up

Discussion Point 1: The planned de-risking strategy

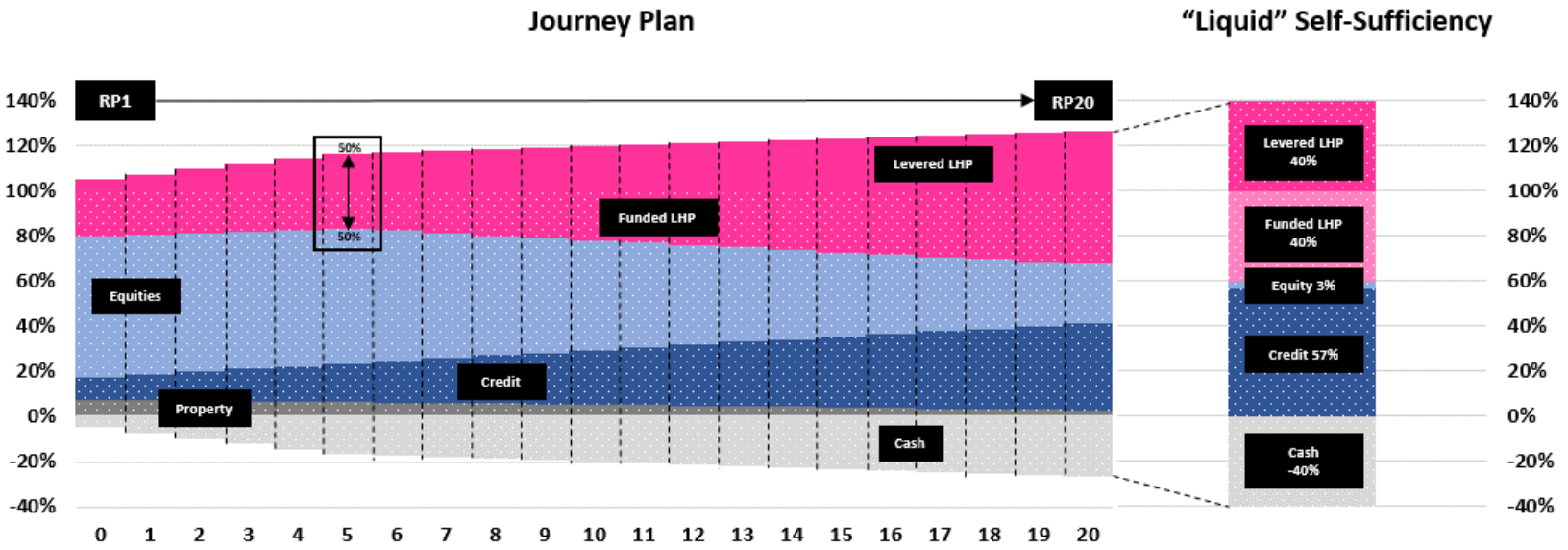
Derisking strategies reduce expected return as well as risk





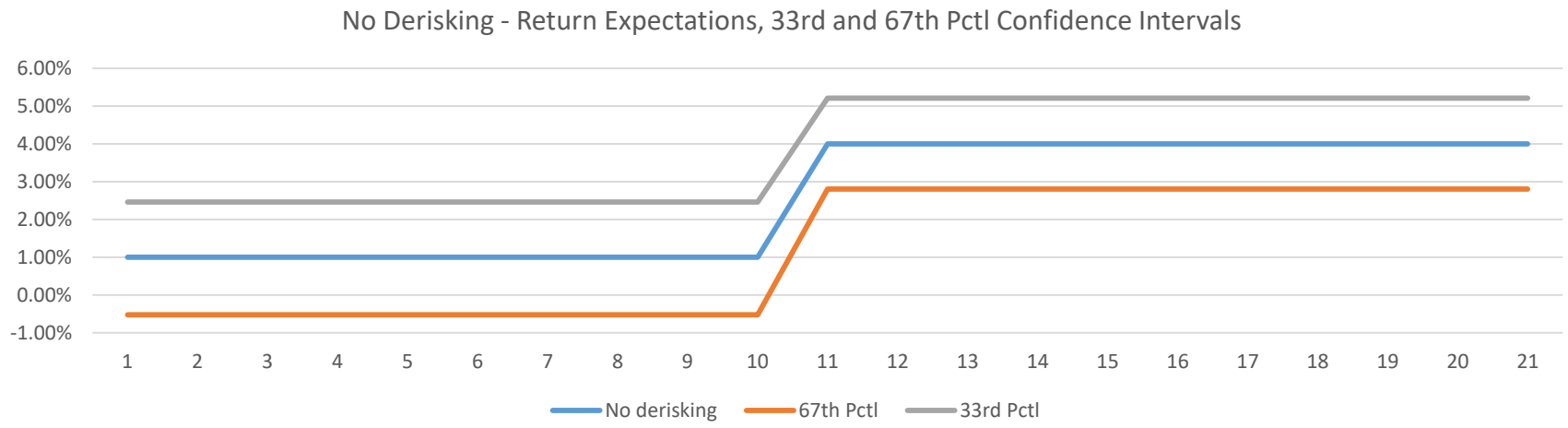
Early derisking takes a longer, slower approach to reducing risk with the same end point and more return-seeking assets

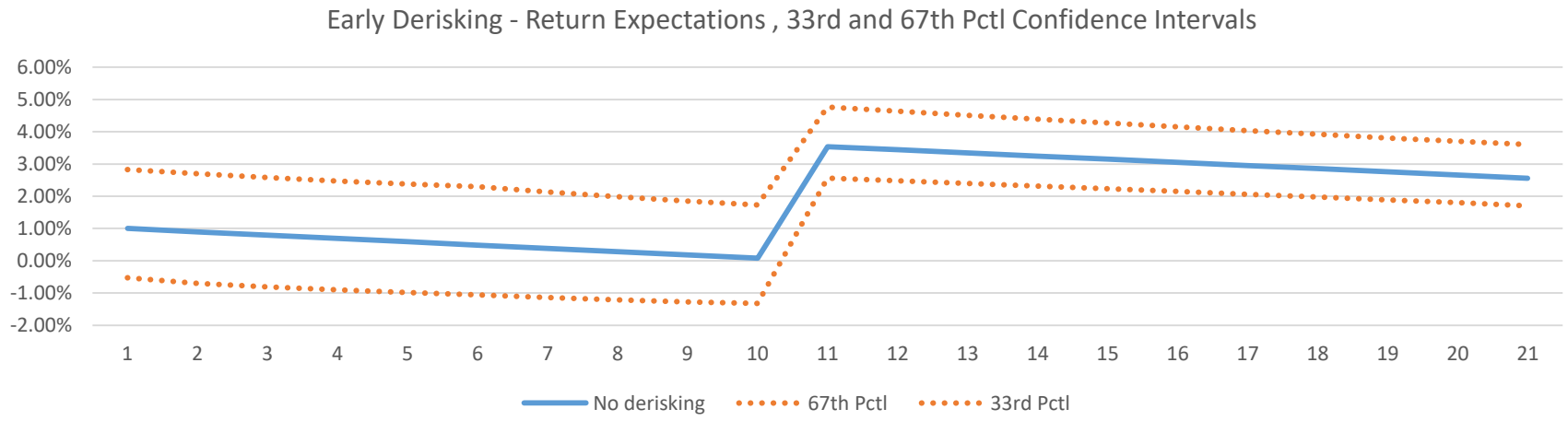
- Early derisking allows for a linear increase in liability hedging assets along with accelerated leverage in the early years.
- This approach facilitates the build-up of hedging assets over the near term, whilst limiting the amount of return-seeking asset disposals during the reversion period.
- Whilst the improvement to AL Risk under this approach is more limited relative to a fully funded LDI build up, it ensures the expected portfolio return is maintained at a higher level. A graphical representation of this process is shown below.



Future distributions of investment *portfolio* returns

The following two charts outline the central case return expectations and associated confidence intervals for two potential future investment strategies:



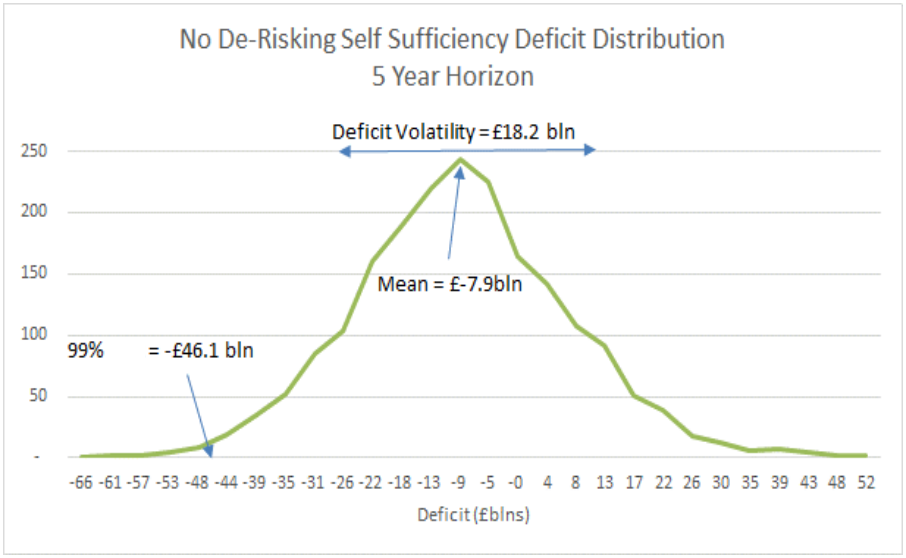


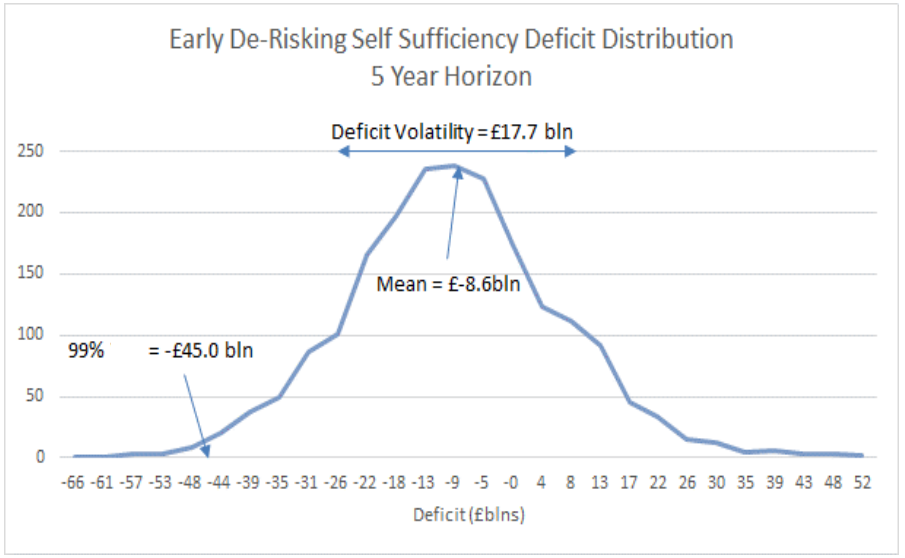
Future distributions of investment portfolio returns

The following charts show the histograms of projected Self Sufficiency Deficit at both a 5 and 10 year horizon* for two separate investment strategies:

- No de-risking
- Early de-risking

5 Year Horizon:





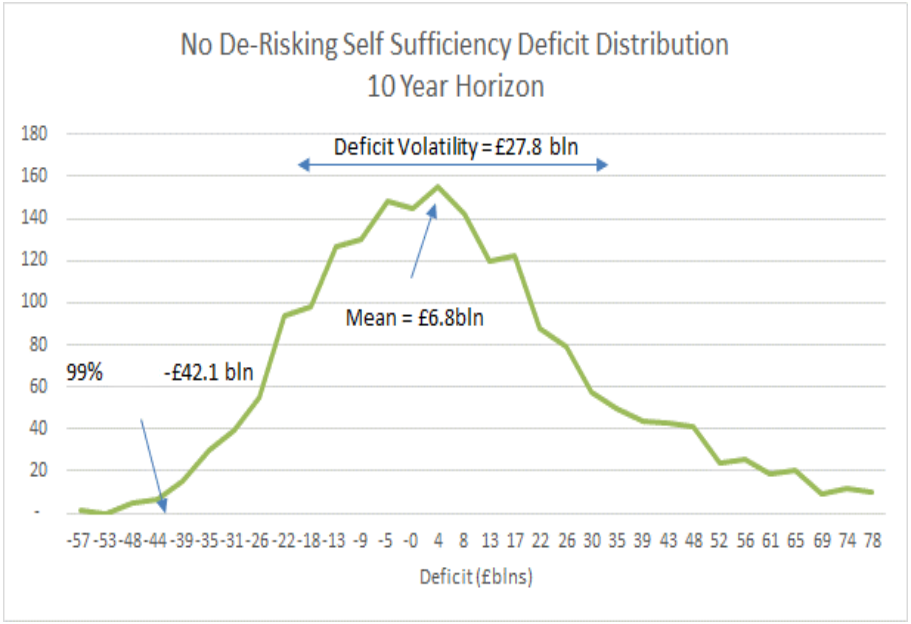
99% VaR = £38.2 bn

99% VaR = £36.4 bn

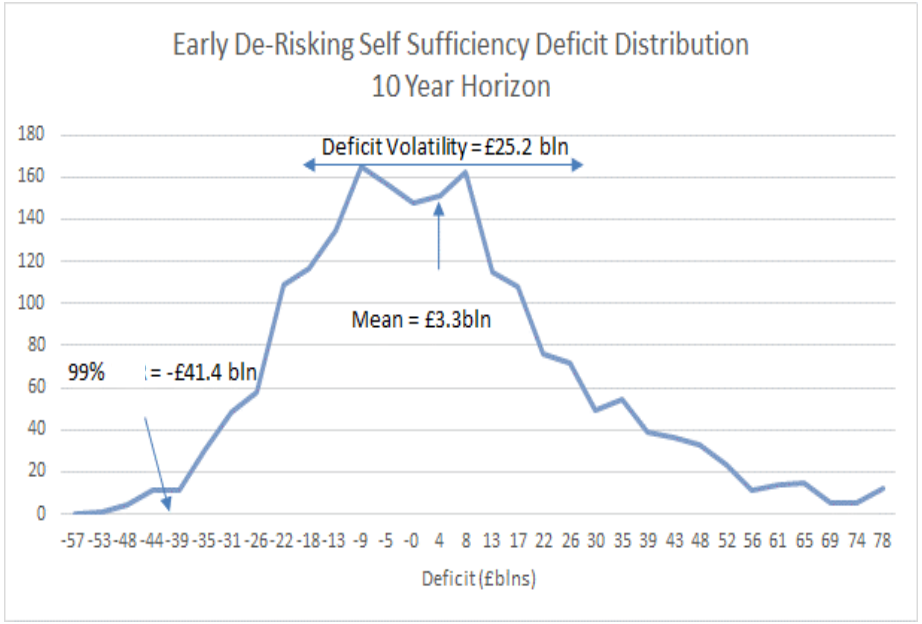
- For this exercise we assume current benefits only (i.e. zero future accrual), and further assume a 4% employer Contribution over the full horizon)
- Note: 99% VaR is merely used as an example risk metric for the tails. It is not our primary metric.

Future distributions of investment portfolio returns (Cont.)

10 Year Horizon:



99% VaR = £48.9 bn



99% VaR = £44.7 bn

- For this exercise we assume current benefits only (i.e. zero future accrual), and further assume a 4% employer Contribution over the full horizon)
- Note: 99% VaR is merely used as an example risk metric for the tails. It is not our primary metric.

JNC 148-3 Annex G.pdf

Discussion Point 2: Methodology, inputs and outputs – transparency questions

Response to the five detailed comments in section 2.3

Point 1: Speed of Convergence.

Future Return and yield expectations are built up via a "Fundamental Building Block" approach (FBB).

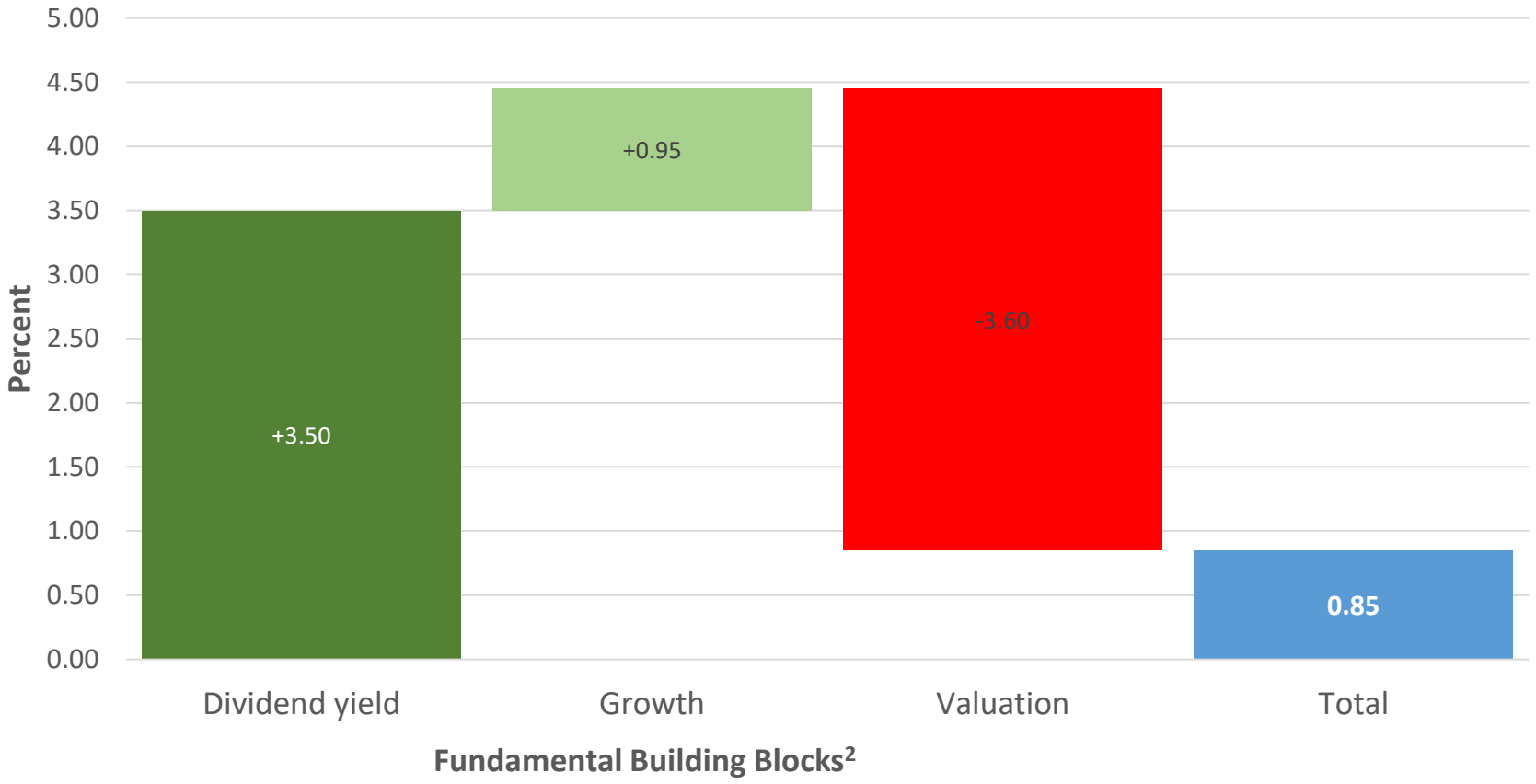
The FBB expectations are split into two distinct periods:

- Years 1-10: **Yield Reversionary Period.**
  - Over this period, UK real and nominal yields are predicted to increase from current historical lows to a level more consistent with history and UK economic fundamentals
  - Growth assets predicted to generally underperform their historical observations given current elevated levels and poor near-medium outlook
- **Years 11-30: Steady State (Equilibrium) Period**
  - At this stage UK real and nominal yield curves have converged to their long term expectations.
    - UK 20 year Real Yield = -0.25% (from -1.75% @ Mar 2017)
    - UK 20 year Nominal Yield = +3.03% (from +1.83% @ Mar 2017)
  - Growth assets assumed to have reverted to longer term return expectations consistent with historical fundamentals

Point 1: Speed of Convergence Examples

UK Equities

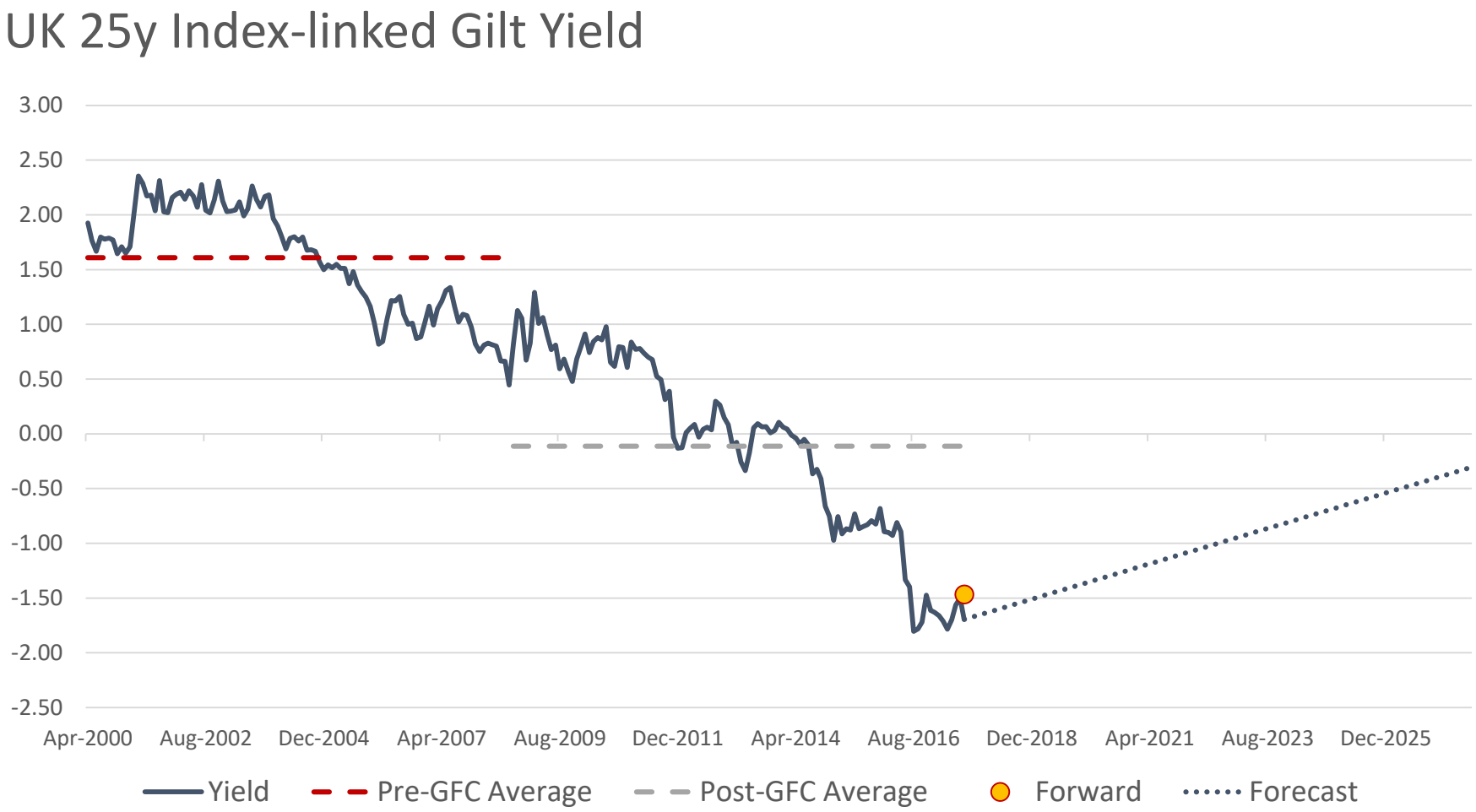
10 year expected returns (%, ann., real)[1]



Data as at 31-Aug-2017; Sources: Datastream, USS

1. Expected returns are given as 10 year real (relative to UK CPI) annualised returns (geometric) for the MSCI UK equities index
2. Growth refers to Earnings per Share growth, Valuation refers to change in price based on mean reversion of Price to Earnings ratio

Point 1: Speed of Convergence Examples



Data as at 31-Aug-2017; Sources: Bank of England, USS
Global Financial Crisis (GFC) is taken as Sep-2008. 10 year forecast yield is a weighted average of pre-GFC average yields (20%), post-GFC average yields (40%) and current market forward (40%)

Point 1: Speed of Convergence Examples

Full March 2017 FBB Return Expectations

	30-Year Expected Real Returns	30-Year Expected Nominal Returns	10-Year Expected Real Returns	10-Year Expected Nominal Returns	10Y Forward 20Y Returns (Real)
UK Equity	3.33%	5.65%	2.00%	4.30%	4.00%
North America Equity	3.32%	5.65%	0.80%	3.07%	4.61%
Europe ex UK Equity	3.05%	5.37%	1.53%	3.81%	3.82%
Pacific Equity	3.01%	5.33%	1.97%	4.26%	3.54%
Emerging Market Equity	5.78%	8.16%	5.00%	7.36%	6.18%
UK Credit	0.94%	3.21%	-1.37%	0.85%	2.12%
Global Credit	0.77%	3.04%	-0.22%	2.03%	1.27%
Global High Yield	2.08%	4.38%	1.01%	3.28%	2.63%
EMD Hard	3.15%	5.47%	0.47%	2.73%	4.51%
EMD Local	3.86%	6.19%	3.84%	6.18%	3.87%
UK Property	3.23%	5.56%	2.56%	4.86%	3.57%
UK Nominal Gilts (30-year)	-0.29%	1.96%	-2.41%	-0.22%	0.80%
UK Index Linked Gilts	-0.76%	1.47%	-3.82%	-1.66%	0.80%
Cash	-0.56%	1.68%	-1.10%	1.12%	-0.29%
Equities	3.64%	5.97%	1.91%	4.20%	4.52%
Property	3.23%	5.56%	2.56%	4.86%	3.57%
Listed Credit	1.45%	3.73%	-0.14%	2.11%	2.25%
Index Linked Bonds	-0.76%	1.47%	-3.82%	-1.66%	0.80%
Cash	-0.56%	1.68%	-1.10%	1.12%	-0.29%

Point 2: Incorporating FBB into GLASS via the Calibration Process

- "Base" Ortec economy calibrated such that:
  - The **geometric mean** of each underlying Reference Portfolio asset class reflects the USS "FBB" central case expectation.
  - The relevant yield curves evolve as per the central expectation
  - All relevant econometric variables (RPI, CPI etc.) follow the USS projections
  - This is an iterative process in which the **central cases** of each variable are ultimately "nudged" to match the USS expectation. Crucially we do not tamper with the covariance structure **between** variables, nor do we adjust the volatility structures inherent tail dependencies.
- Reference Portfolio Investment Strategy replicated within the GLASS node structure
  - LDI component modelled such that PV01 and IE01 match the economic liabilities along each scenario and for each time step
  - This Process gives rise to an observed Rebalancing/Diversification Premium

Appendix

Importance of the stochastic simulation model

- Precise specification of stochastic modelling is most significant when analysing:

  i. Outcomes in the tails for the distributions

  ii. Certain non-diversified or highly non-linear strategies

- When working within the "body" of a simulated distribution of projected returns or asset values for a well diversified portfolio consisting of plain vanilla instruments, the outcome can be estimated with reasonable accuracy based on two parameters:

  i. Central path
  ii. Volatility of the distribution

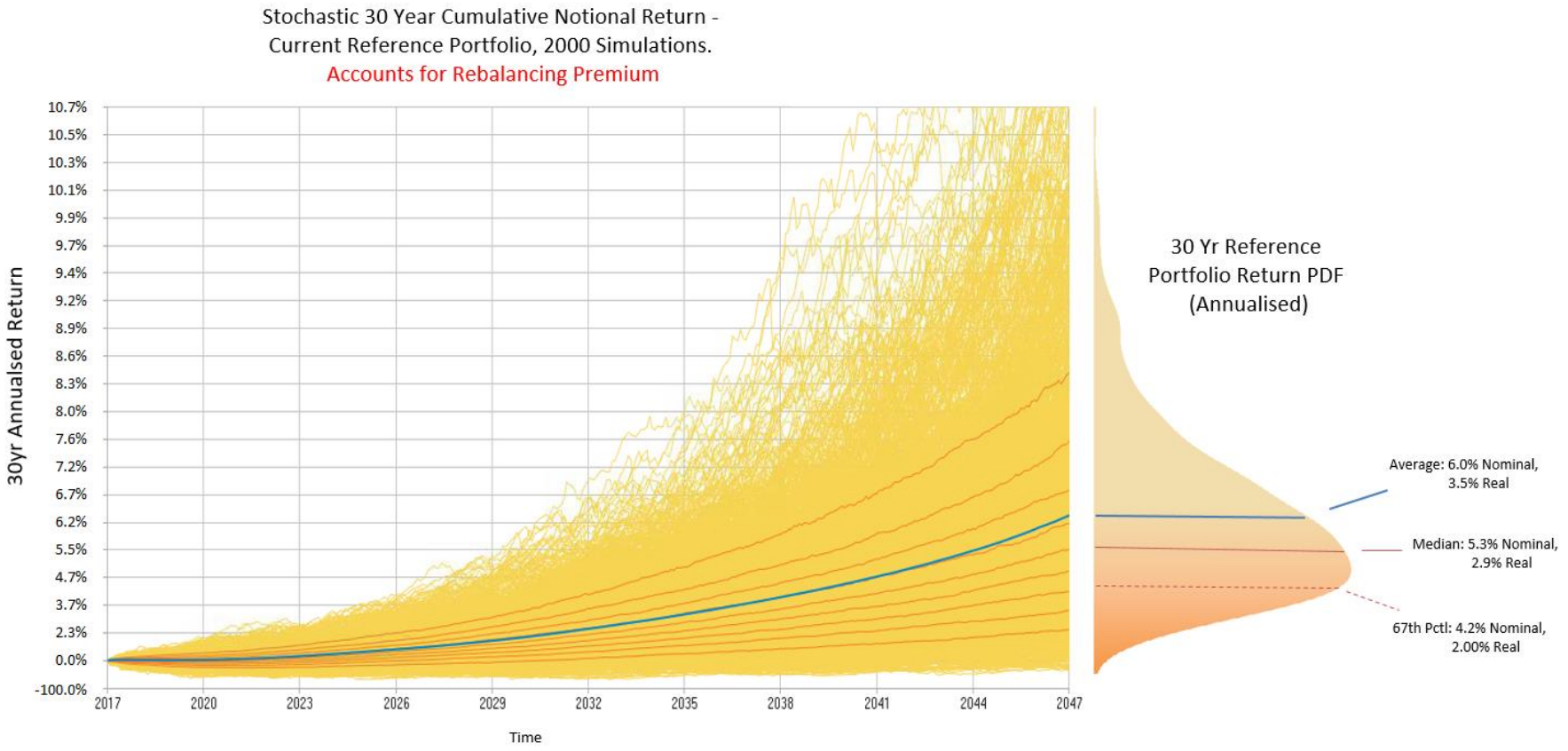
- Hence the precise details of the simulation models are not necessary to "validate" many of the outputs used in the valuation

- An Example of this dynamic is shown in the following 2 slides

Importance of the stochastic simulation model – Example

- Using the calibrated economy, well defined assumptions and accurately specified projection variables, a multitude of ALM projections can be analysed.

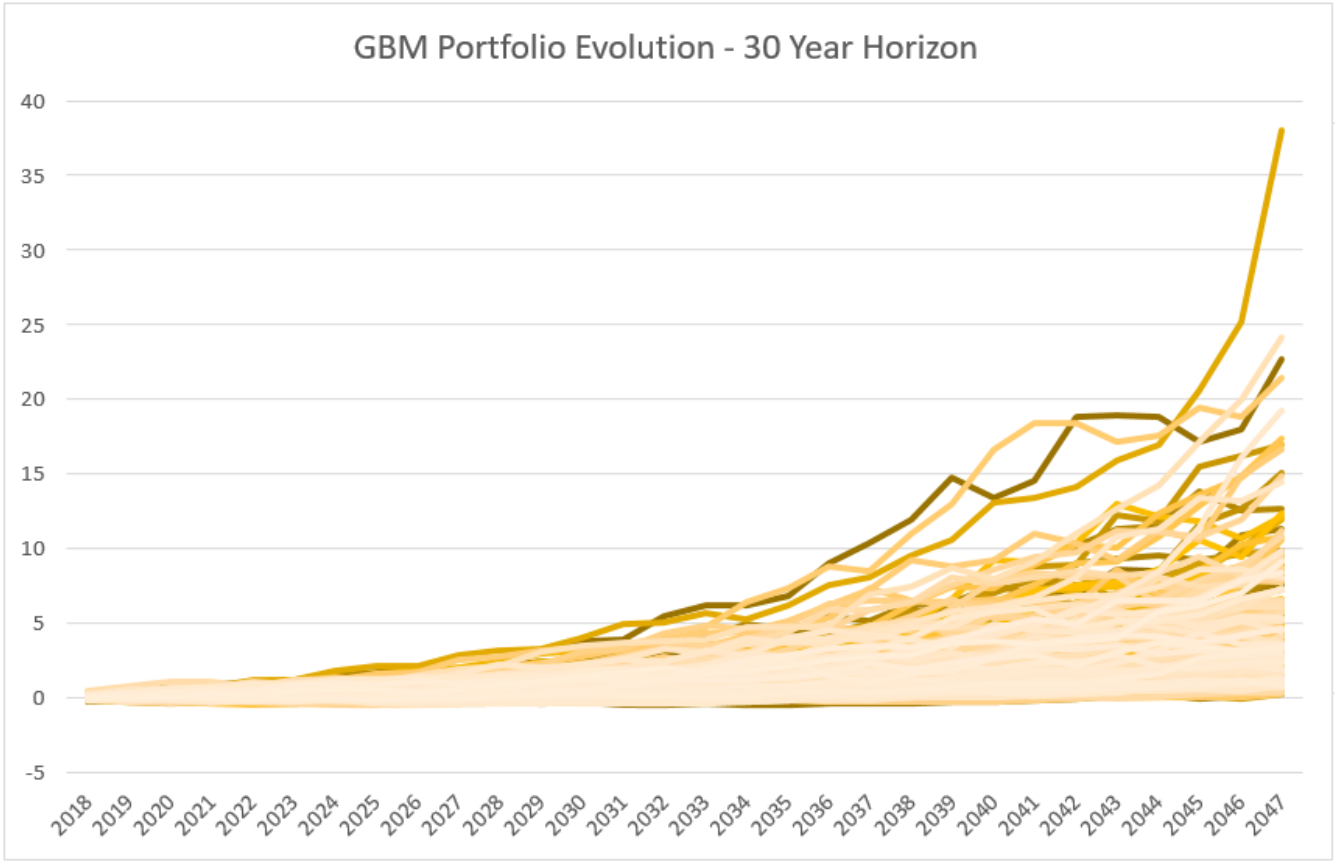
The chart below shows the Reference Portfolio 30 year return evolution as per the GLASS stochastic simulation.

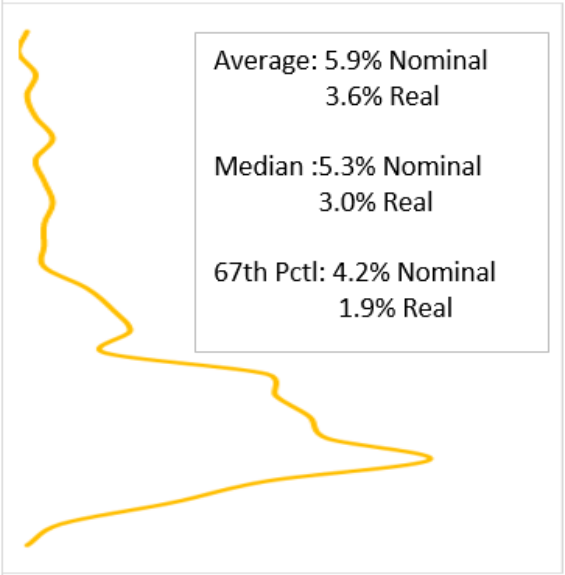


Importance of the stochastic simulation model – Example (Cont.)

- The Chart below outlines the result we generate by stochastically projecting the portfolio forward over a 30 year period via a Geometric Brownian Motion Approach.
- We apply the central case return expectation and portfolio volatility as per the GLASS analysis

Notice the Similarity to the non-normal GLASS simulation





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