March Topical Issues

29 March 2022
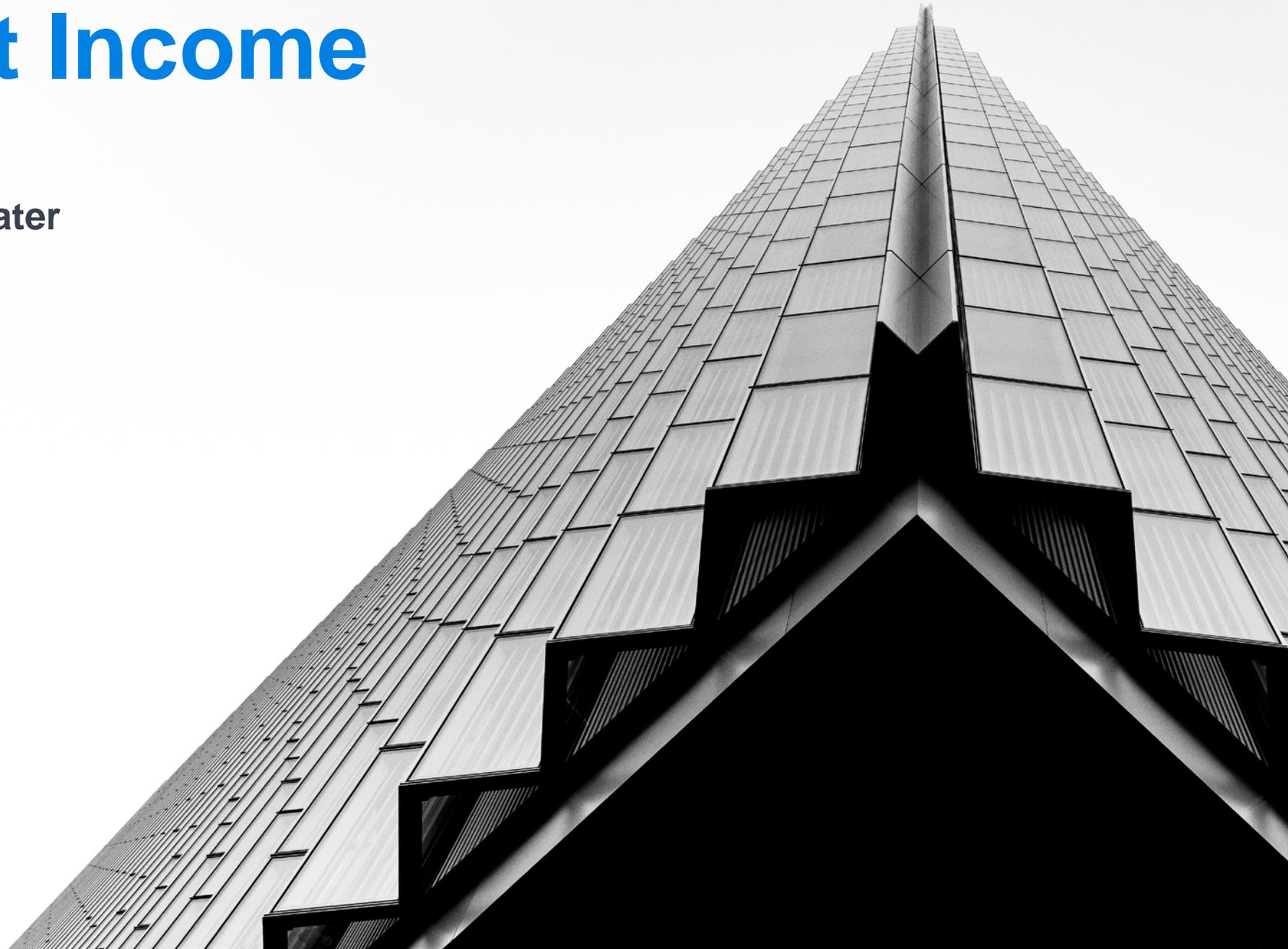
Retirement Income

A bridge over troubled water

Neil Dissanayake, Russell Ward

MARCH 31, 2022

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Agenda

I. DC market perspective - survey insights

II. Closing the gap - approaches to sustainable income

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DC market perspective - survey insights

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Introduction

- Survey undertaken in partnership with Mallowstreet

- Conducted in Q1 2022

- Participants were 22 DC schemes and master trusts

Objective - to gauge industry support for the development of drawdown solutions offering a sustainable level of income.

mallowstreet
DC Retirement Solutions
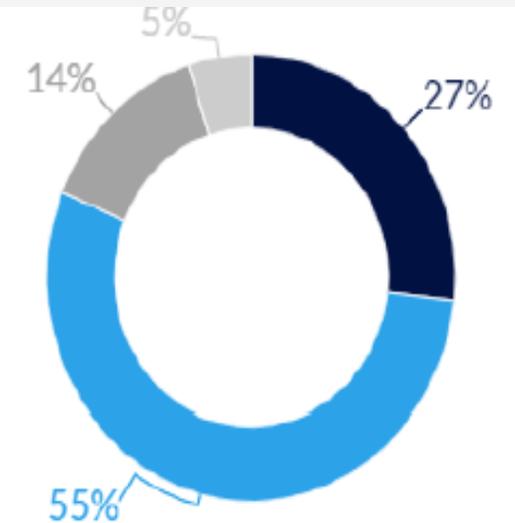
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FLASH REPORT

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Survey Highlights

Schemes agree they have a role to play in ensuring adequate DC outcomes for members

- We see very strong support for schemes providing information on sustainable income levels to members at retirement.

- However, less than half the participants feel they should go further and offer guidance or default solutions.

- During retirement, the favoured approach is to provide tools enabling members to reassess income sustainability themselves.

A PENSION FUND SHOULD ADDRESS THE RISK OF MEMBERS WITHDRAWING MORE FROM THEIR PENSION POT THAN IS DEEMED SUSTAINABLE FOR A LIFETIME INCOME.

5%
14%
27%
55%

- Strongly agree
- Somewhat agree
- Somewhat disagree
- Strongly disagree

Milliman Comment

Current views place a great deal of emphasis on member engagement, proactivity and diligent action based on a good understanding of the information provided.

Survey Highlights

Income sustainability and inflation protection are seen as key factors in setting guided income levels

Milliman Comment

- We feel the ranking of priorities reflects a blend of aspiration and pragmatism.

- Some priority combinations will be difficult to reconcile – for example an income level that is always set to be sustainable in light of realised investment performance may not provide increases which match inflation.

- It is encouraging though to see acknowledgement that income levels may need to be adjusted down as well as up on occasion, with the requirement that income levels do not fall ranked last.

The pyramid illustrates participants' priority ranking of the retirement income features described:

FACTORS IN SETTING GUIDED INCOME LEVELS

The income level is always sustainable given the current fund level — 1

The income level provides an inflationary increase each year — 2

The income level is relatively stable throughout retirement — 3

There is a limit to how much total income can go below initial expectations — 4

The income level does not decrease from one year to the next — 5

Survey Highlights

Views differ around likely member expectations for drawdown income

- About 50% of participants agreed that it would be important for income levels to be comparable to an annuity.

- Around 40% agreed that members entering drawdown would expect an initial income level higher than an annuity to compensate for the lack of a guarantee.

- On the other hand, about 30% agreed that as drawdown offers greater flexibility, members would be willing to accept an initial income level below that of an annuity.

IS IT POSSIBLE TO MANAGE MEMBER EXPECTATIONS TO ALLOW FOR POTENTIAL CUTS IN DRAWDOWN INCOME?

9%

91%

● Yes ● No
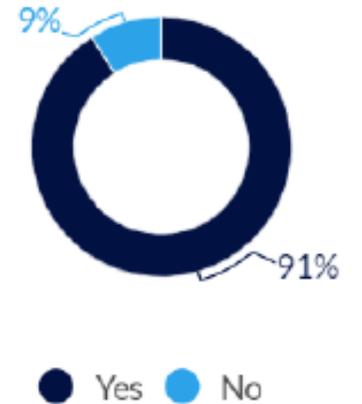
Milliman Comment

- It is natural to expect that members may use annuity income levels as a reference point in setting their drawdown income.

- However, the many differences between annuities and drawdown means any annuity benchmark needs careful interpretation. Indeed, conveying this information clearly and appropriately without significant knowledge of members' circumstances will be challenging.

- We note the strong support for educating members to manage sustainability risk via a dynamic approach to income level.
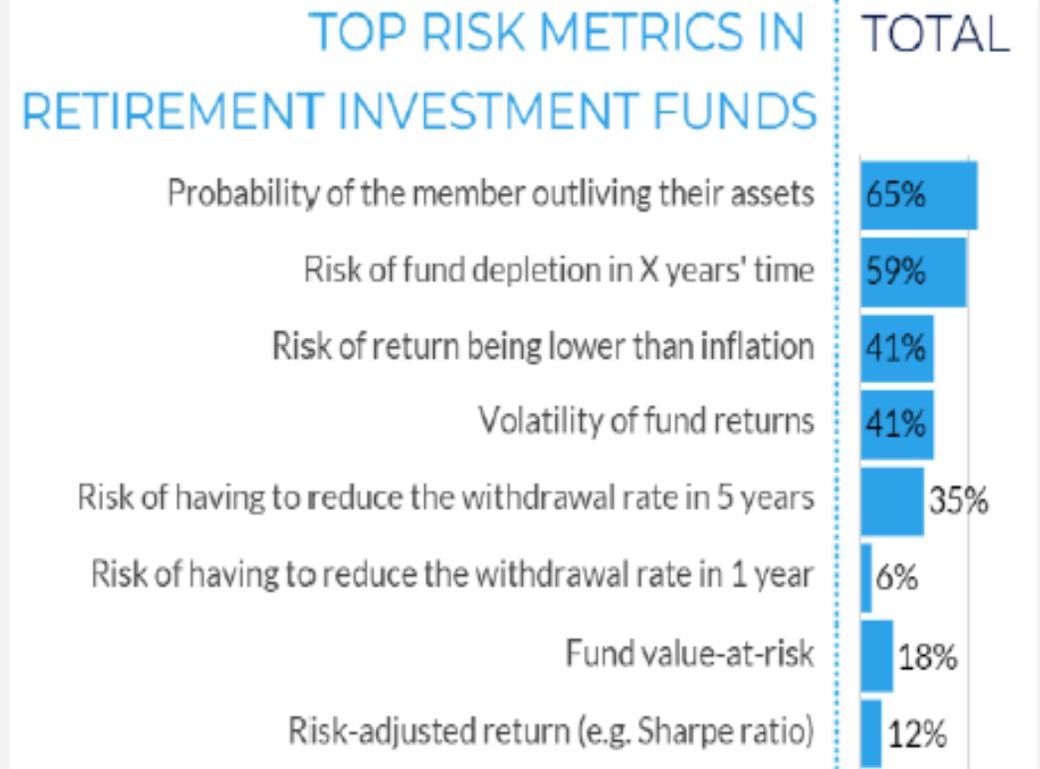
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Survey Highlights

Risk in decumulation should be measured via tailored metrics

Milliman Comment

We see the responses as broadly consistent with the ranking of retirement income features. In particular:

- The top 2 metrics are clearly aligned with a focus on the sustainability of income.

- The 3rd metric aligns to a desire to have an income that increases with inflation.

- The 4th metric is consistent with the aim of having an income that is broadly stable over time.

- We note that commonly used risk measures in the accumulation phase see relatively little support, reinforcing the sense that the decumulation phase requires its own bespoke risk management framework.
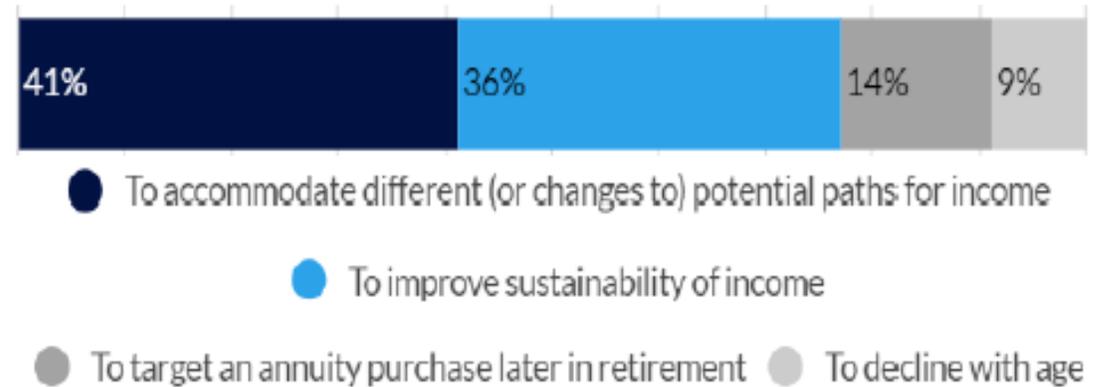
TOP RISK METRICS IN RETIREMENT INVESTMENT FUNDS	TOTAL
Probability of the member outliving their assets	65%
Risk of fund depletion in X years' time	59%
Risk of return being lower than inflation	41%
Volatility of fund returns	41%
Risk of having to reduce the withdrawal rate in 5 years	35%
Risk of having to reduce the withdrawal rate in 1 year	6%
Fund value-at-risk	18%
Risk-adjusted return (e.g. Sharpe ratio)	12%

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Survey Highlights

Investment risk should be managed alongside income reviews and its value recognised
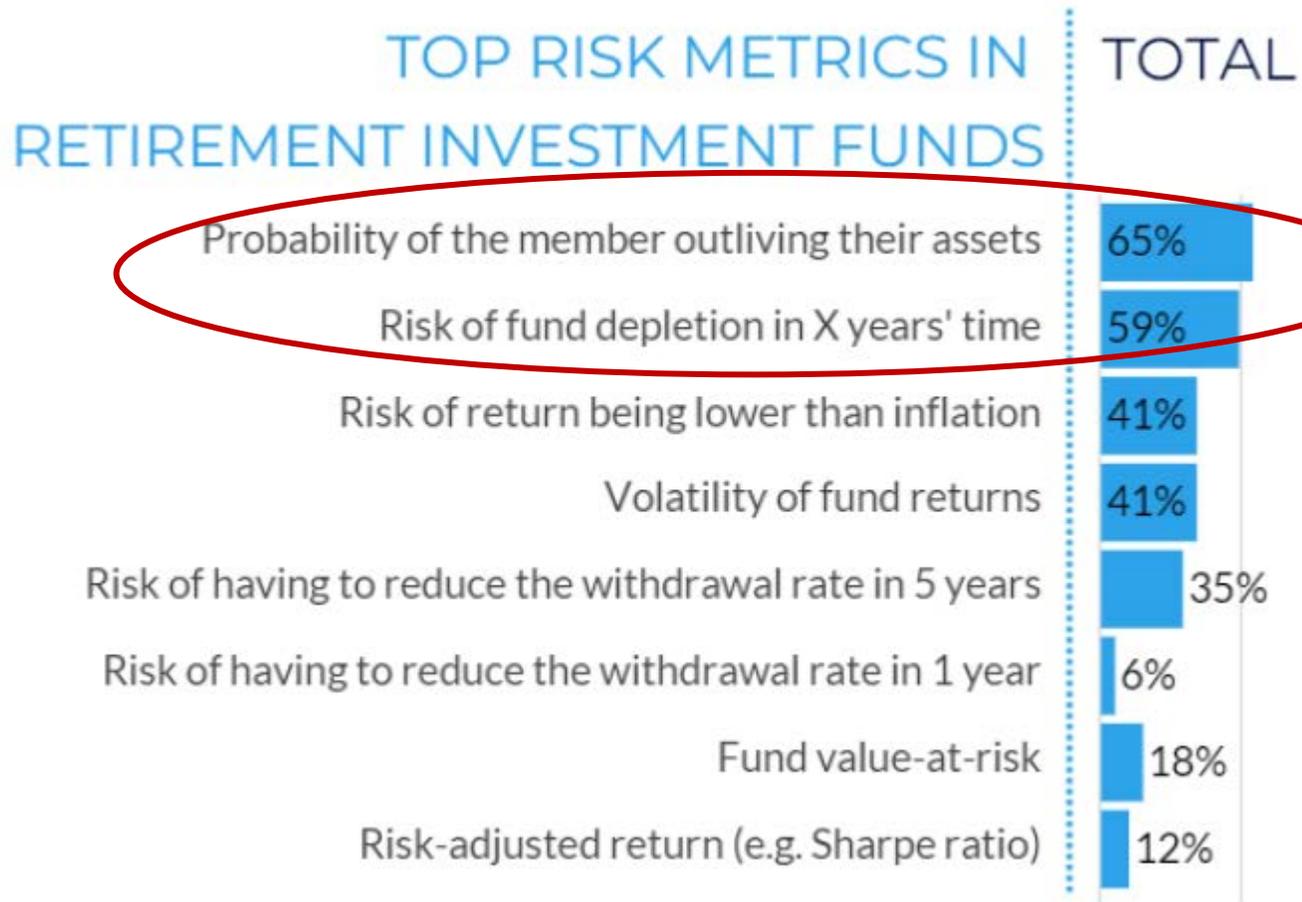
Milliman Comment

- Right up front we noted that 82% of participants agreed that schemes should help members address the risk of exhausting their pension income. Aligned to this, we note the consistent emphasis on sustainability of income.

- To manage the risk, schemes clearly see members themselves playing an important role via income review and adjustment.

- Just over a third also feel investment risk should be managed with sustainability of income as the goal. However, a slightly larger number see an approach more tailored to individual income paths.

- Finally, the majority (67%) of participants felt that risk management approaches should be reflected in value for money (VFM) assessments.

HOW SHOULD INVESTMENT RISK BE MANAGED?

41%	36%	14%	9%

- To accommodate different (or changes to) potential paths for income

- To improve sustainability of income

- To target an annuity purchase later in retirement
- To decline with age

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Closing the gap - approaches to sustainable income

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Managing Risk of Outliving Your Assets

TOP RISK METRICS IN RETIREMENT INVESTMENT FUNDS | TOTAL

- Probability of the member outliving their assets — 65%
- Risk of fund depletion in X years' time — 59%
- Risk of return being lower than inflation — 41%
- Volatility of fund returns — 41%
- Risk of having to reduce the withdrawal rate in 5 years — 35%
- Risk of having to reduce the withdrawal rate in 1 year — 6%
- Fund value-at-risk — 18%
- Risk-adjusted return (e.g. Sharpe ratio) — 12%

If no guarantee,

2 approaches to managing fund depletion risk:

Dynamic Income

Dynamic Assets

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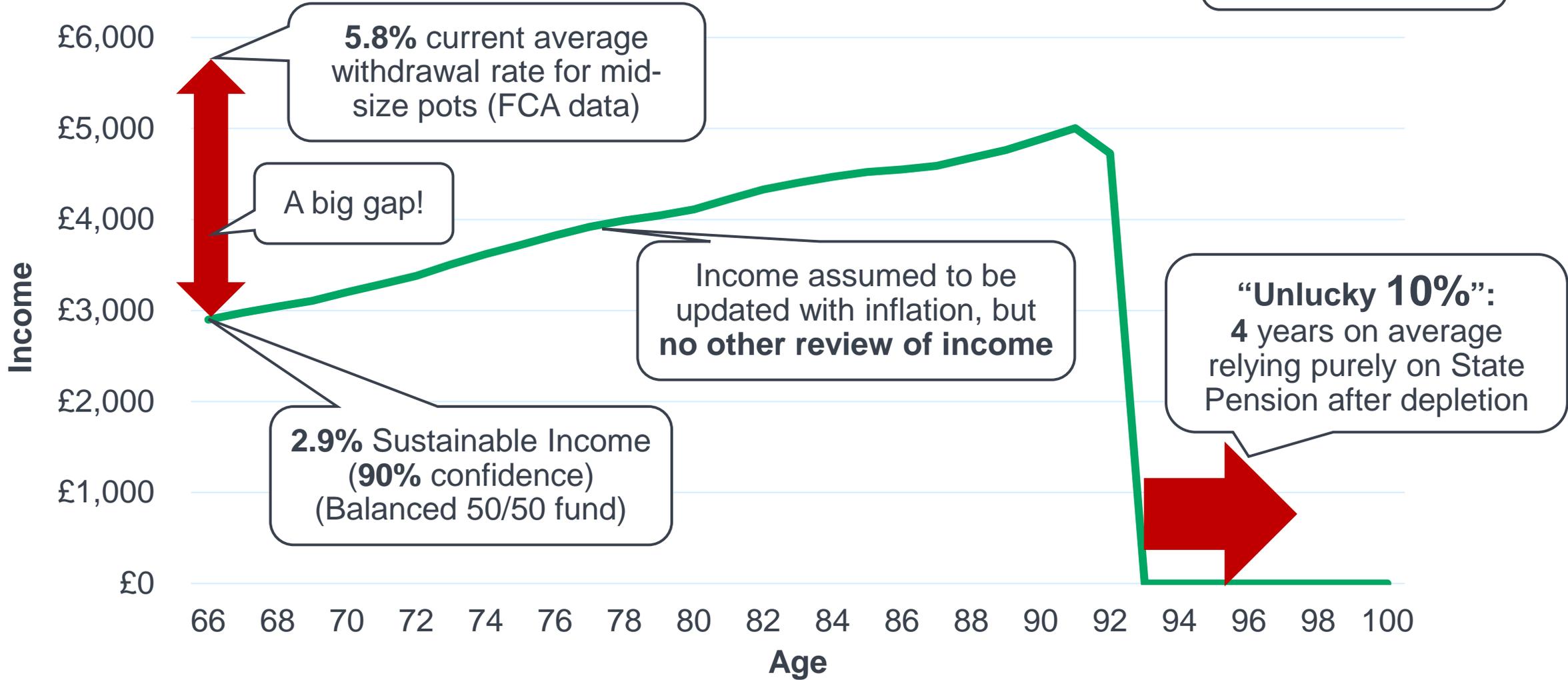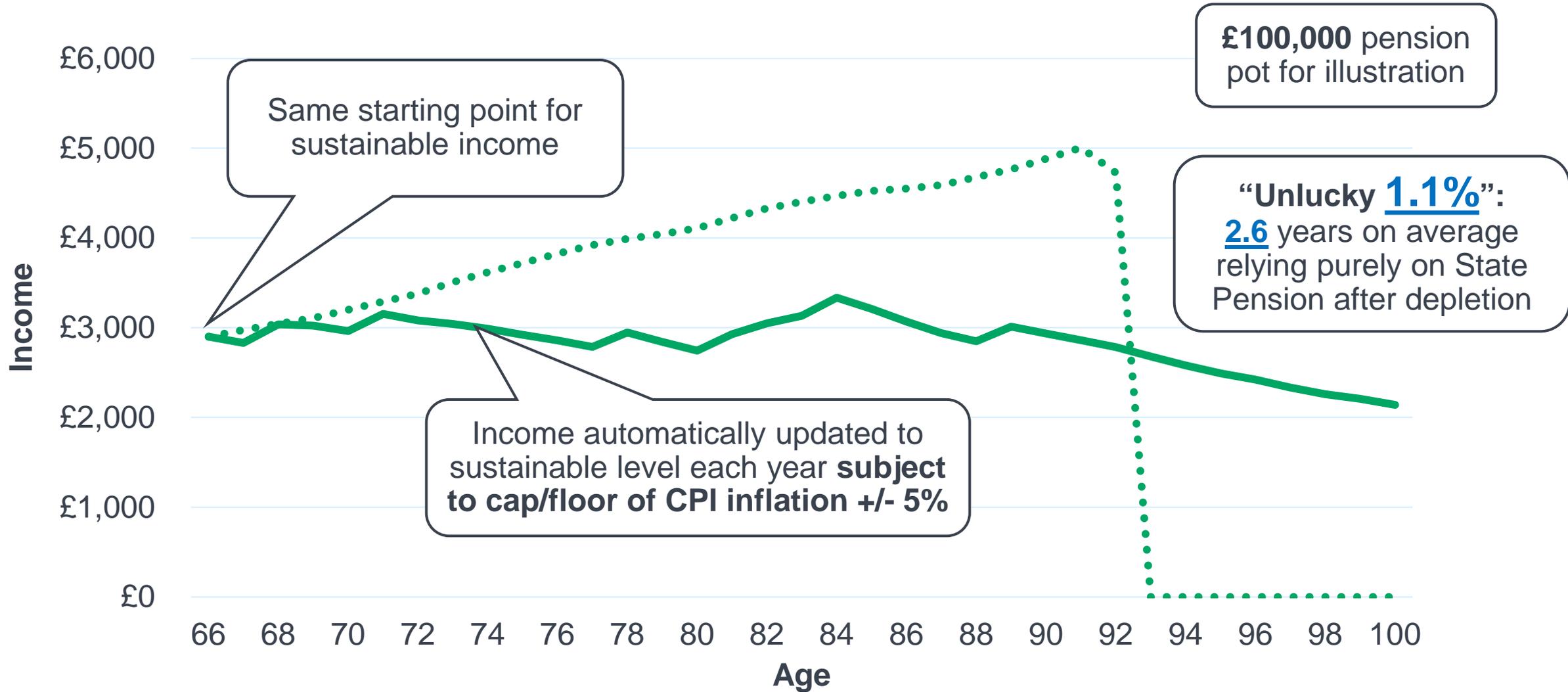
Distribution of Income Paths

Non-Reviewable Drawdown

Range of Income Paths
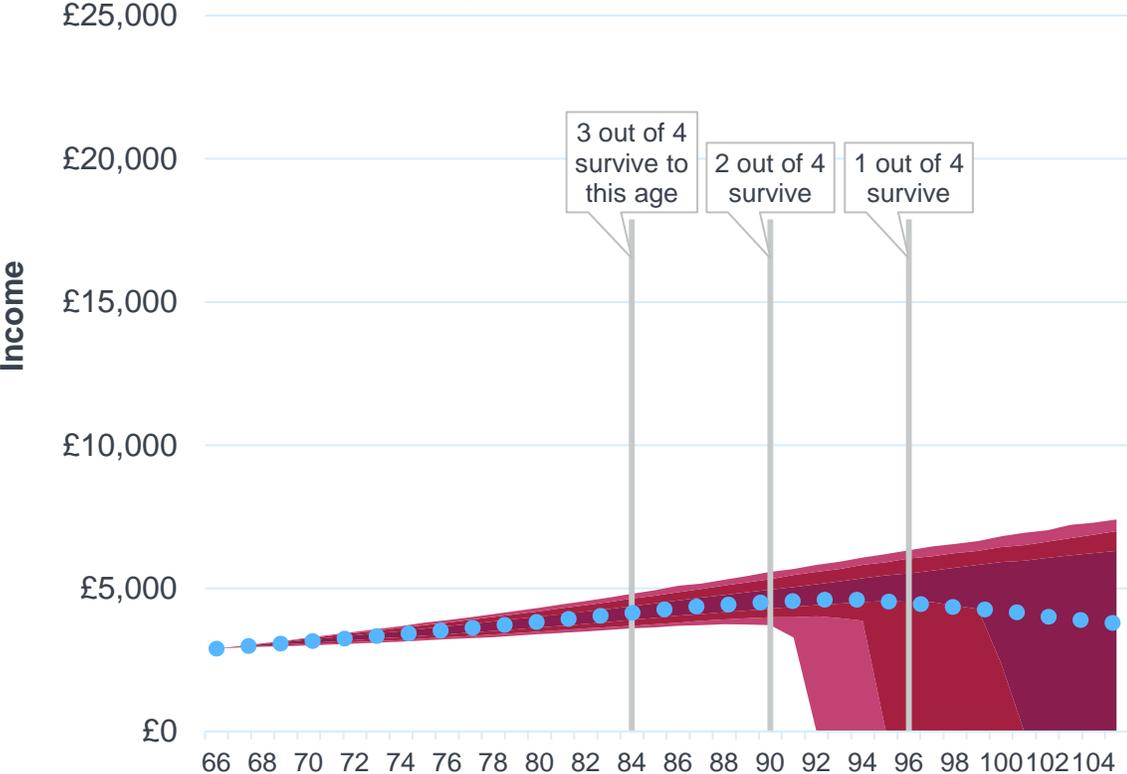
Automatic Annual Income Reviews

Range of Income Paths
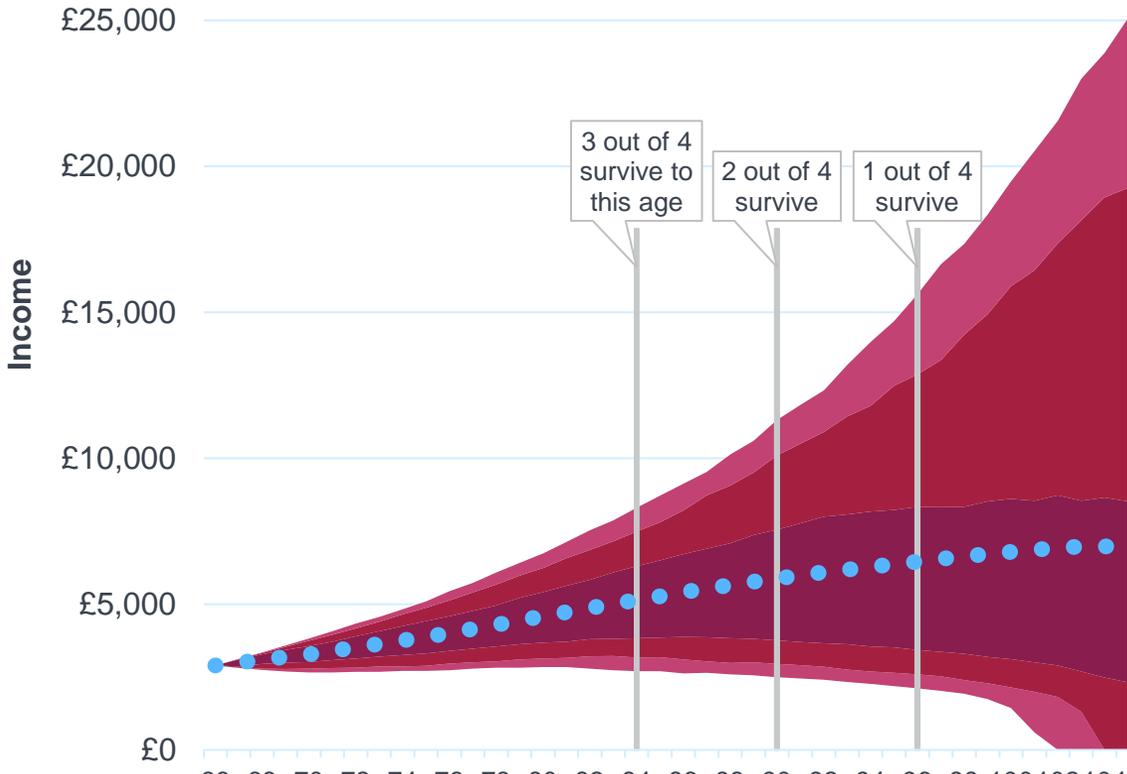
Static Asset Allocation

Static Weight strategy:
(e.g. Equal Weight = 50/50)

```
┌─────────────────┐   ┌─────────────────┐
│  HIGH RISK      │   │  LOW RISK       │
│  environment    │   │  environment    │
└─────────────────┘   └─────────────────┘
        │                     │
        ▼                     ▼
┌─────────────────────────────────────────┐
│  Maintain long-term asset allocations   │
└─────────────────────────────────────────┘
```

Investment Risk

High chance of cuts in income

High chance sustainable income is below income floor

■ **Static Assets - 40% equity/60% bonds**
■ **Static Assets - 60% equity/40% bonds**

Investment risk is defined as the 1-year realised volatility of daily returns

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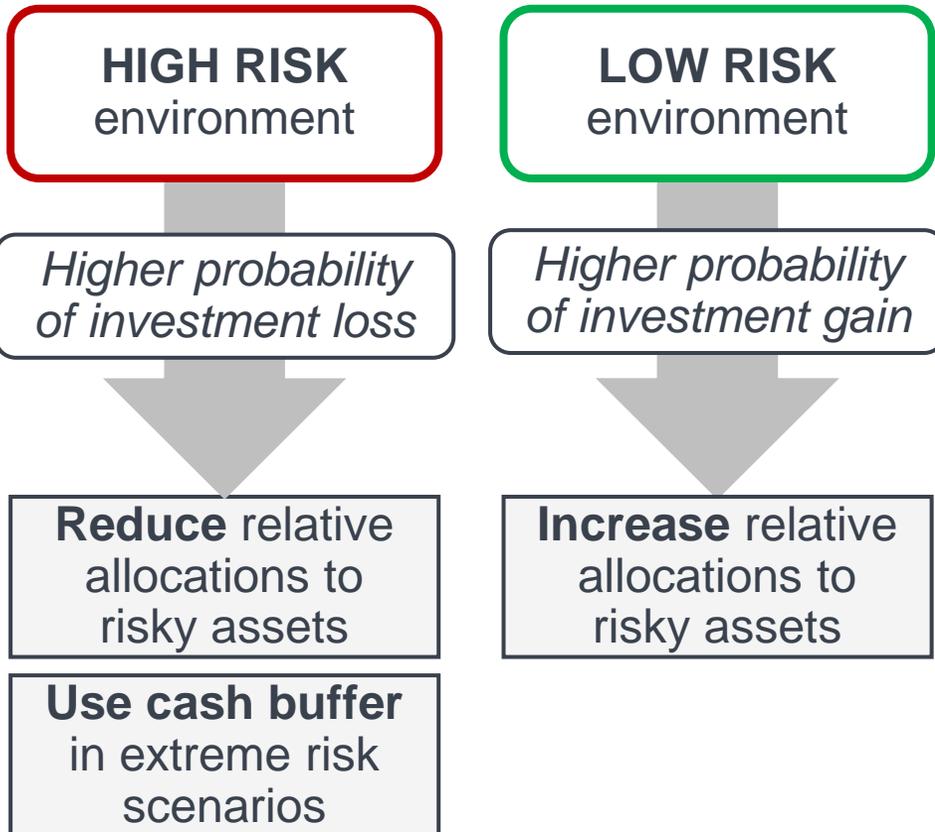
16
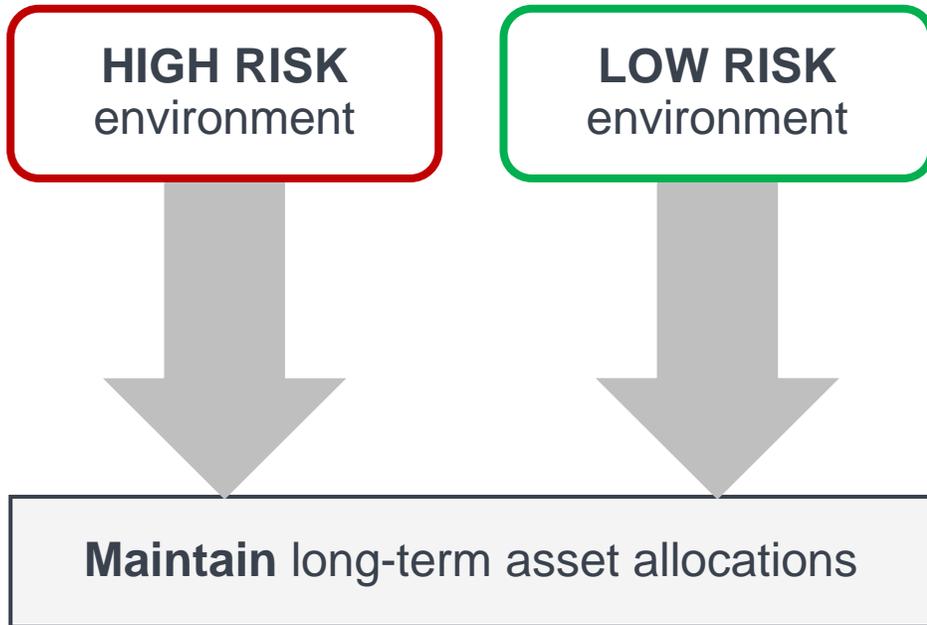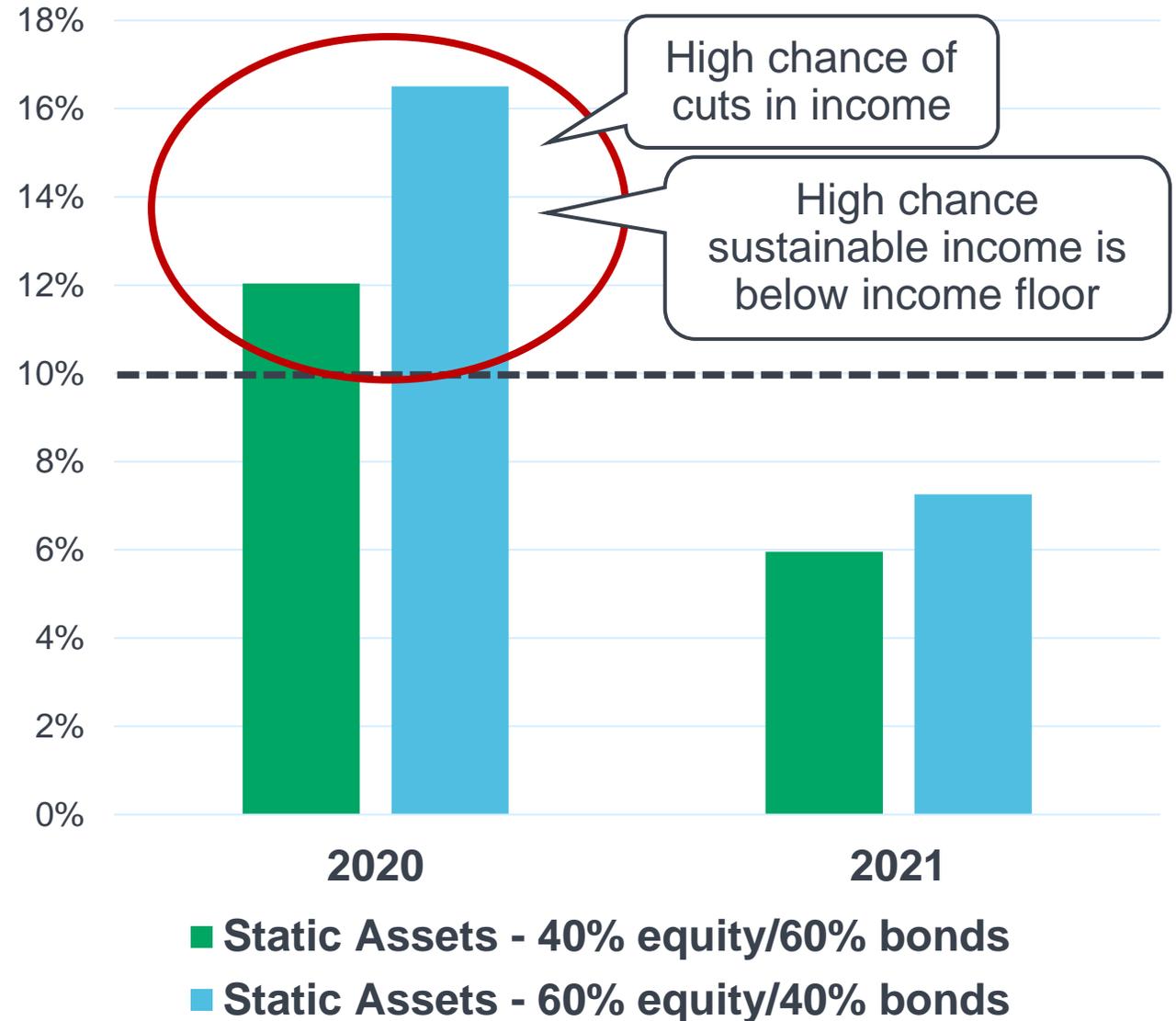
Dynamic Asset Allocation

Equal Risk strategy:

By **dynamic** rebalancing asset weights

HIGH RISK environment	LOW RISK environment
↓	↓
Higher probability of investment loss	*Higher probability of investment gain*
↓	↓
Reduce relative allocations to risky assets	**Increase** relative allocations to risky assets

Use cash buffer in extreme risk scenarios

Investment Risk

More optimal risk profile for supporting a sustainable income

- ■ **Dynamic Assets**
- ■ **Static Assets - 40% equity/60% bonds**
- ■ **Static Assets - 60% equity/40% bonds**

Investment risk is defined as the 1-year realised volatility of daily returns
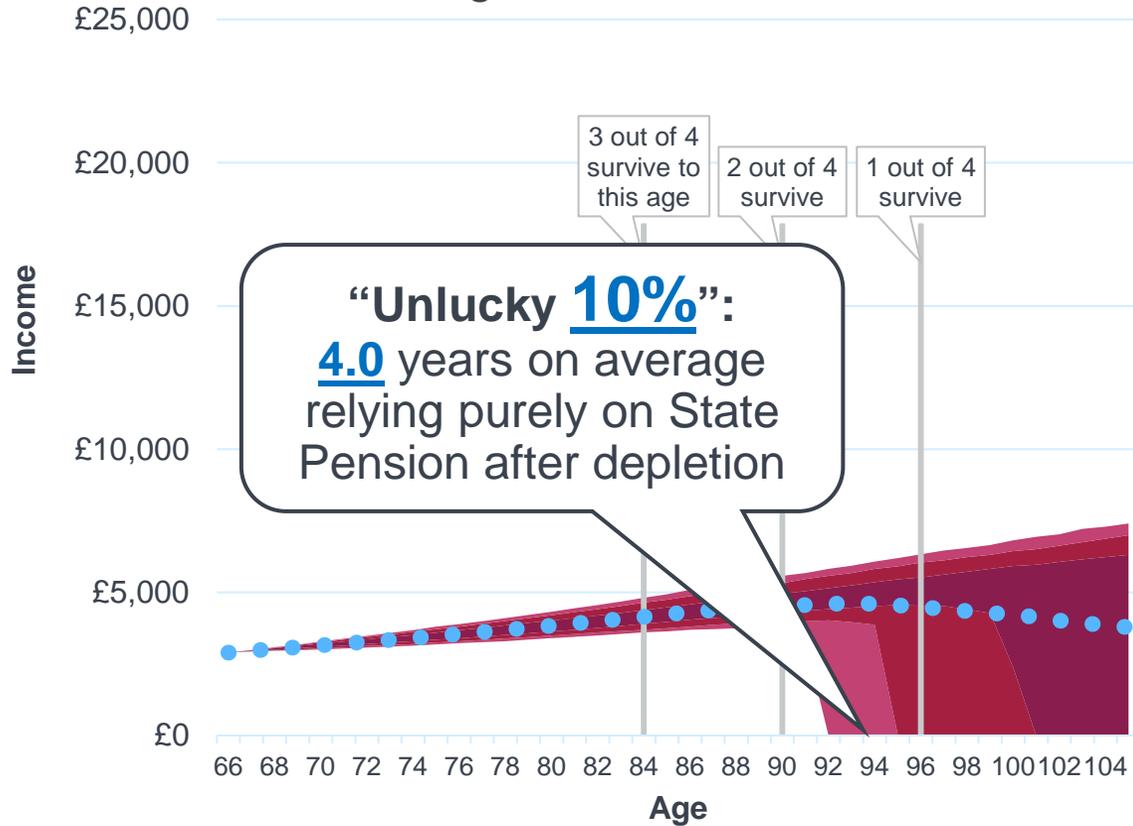
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Static Assets vs Dynamic Assets – Traditional Drawdown
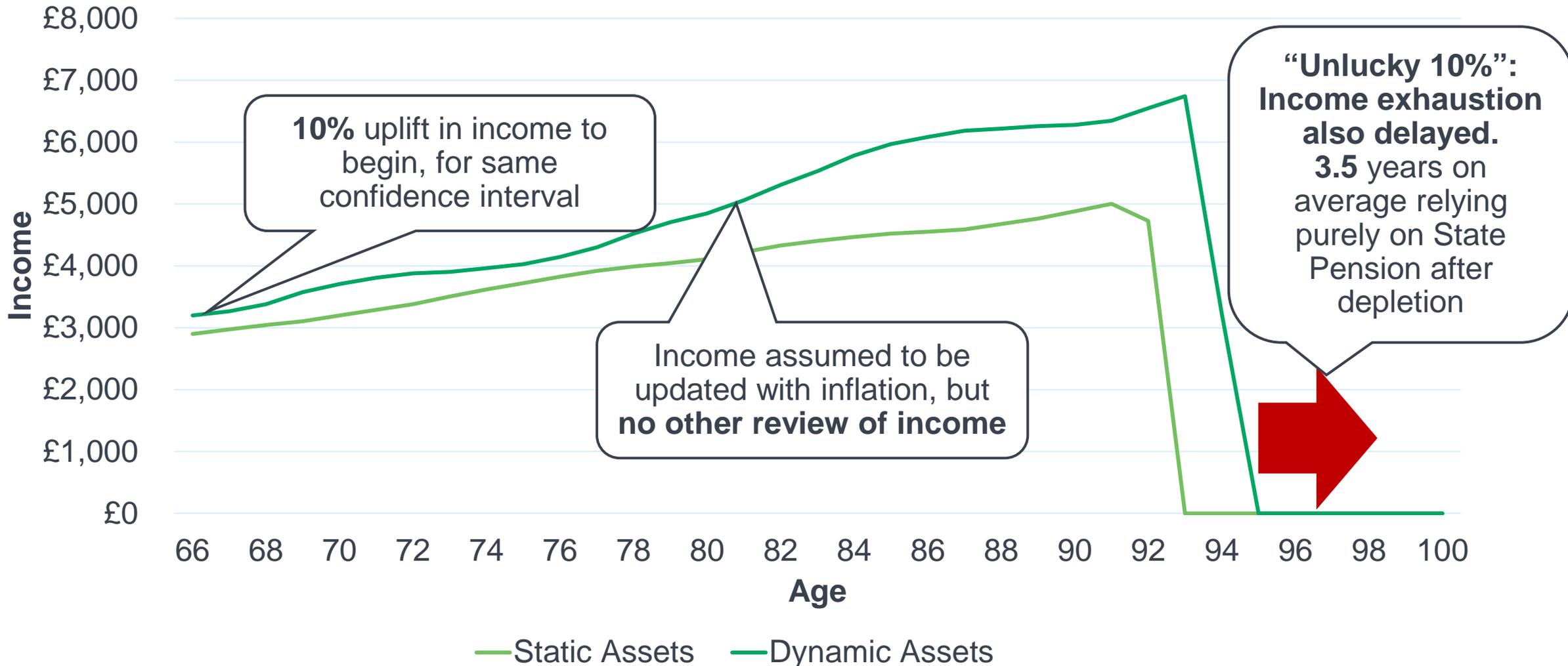
Combined – Dynamic Income and Dynamic Assets

## NON-REVIEWABLE Income + STATIC Assets

Range of Income Paths

3 out of 4 survive to this age

2 out of 4 survive

1 out of 4 survive

"Unlucky 10%": **4.0** years on average relying purely on State Pension after depletion

- 25th to 75th Percentile Range
- 10th to 90th Percentile Range
- 5th to 95th Percentile Range
- Average Income

DYNAMIC Income + DYNAMIC Assets

Range of Income Paths

3 out of 4 survive to this age

2 out of 4 survive

1 out of 4 survive
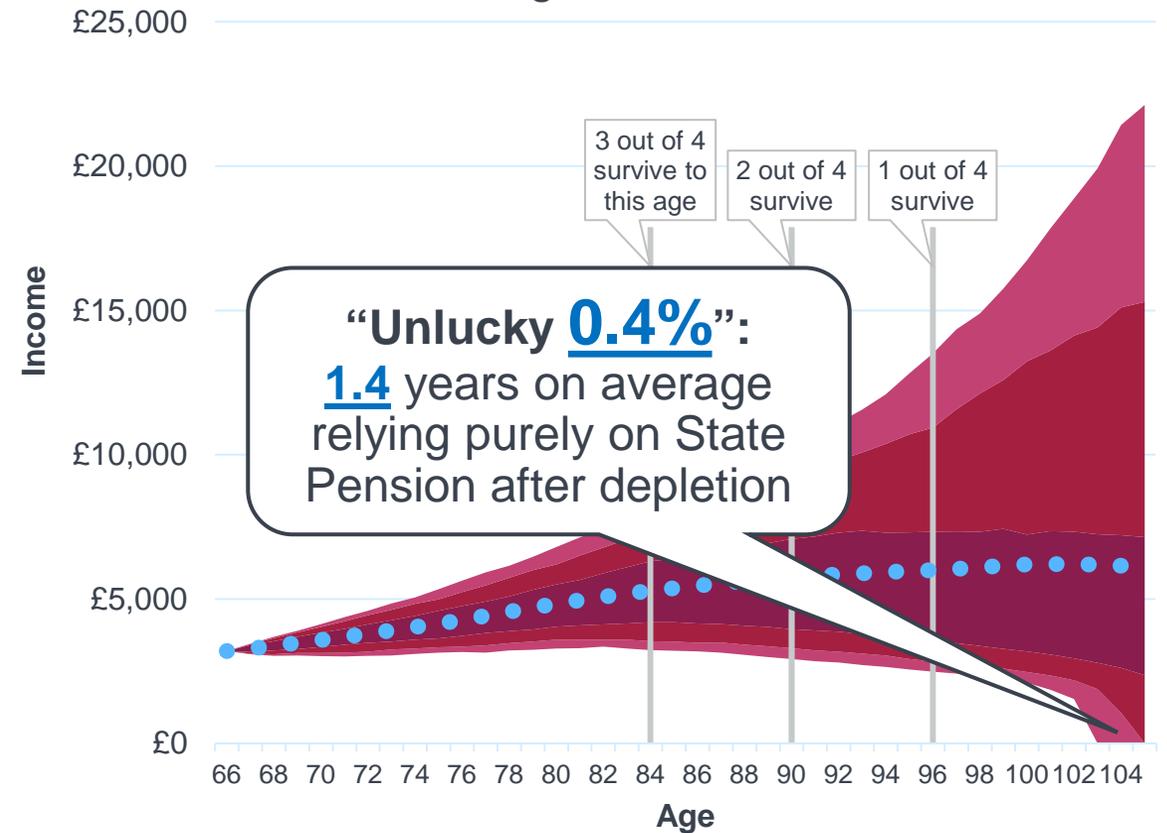
"Unlucky 0.4%": **1.4** years on average relying purely on State Pension after depletion

- 25th to 75th Percentile Range
- 10th to 90th Percentile Range
- 5th to 95th Percentile Range
- Average Income

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Longevity Risk End Game

ANNUITIES

- Difficult to enforce annuity purchase
- Irreversible decision – once selected

COLLECTIVE DC

- Will require scale/collaboration
- Potentially irreversible decision – once in

Intermediate Alternatives?

- Default sacrifice of death benefit at a given age?
- Mechanism to collect assets on death and fund an income uplift for survivors
- Optional death benefit with charge → can (partially) reverse the sacrifice of death benefit

Conclusion

Accumulation → we leverage member inertia to their advantage

- Members are defaulted into a default investment fund
- They have flexibility to "opt out" and "self select" instead

Decumulation → why are we not leveraging member inertia to their advantage?

"Default belief that you would like to maintain a sustainable income for life" could enable:
- Automatic pay out of initial sustainable income level at retirement. Flexibility to reinvest
- Automatic pay out of regular sustainable income. Flexibility to reinvest (or take more)
- Assets managed to optimise risk of running out of money

"Default belief that you would prefer to sacrifice your death benefit at a given age":
- Potentially allows adoption of longevity pooling mechanism

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Appendix

Key assumptions to modelling

Sustainable income calculation:

- Income is inflated each year based upon a stochastically modelled CPI inflation with an expected average of **2.0%** p.a.

- **1,000** real world investment scenarios have been projected. A total fund charge of **0.5%** p.a. is assumed.

- Failure is defined as the probability of surviving to fund depletion where income is no longer able to be supported, assuming each investment scenario has equal probability. Sustainable income is derived as the highest initial income that leads to failure less than **10%.**

- Mortality basis: **80%** of blended **PXA08** mortality (**60%** male/**40%** female) with **CMI_2019** model /**1.5%** long-term improvements

Static asset allocation:

- Future real-world projection scenarios were modelled based upon a stochastic risk-free curve calibrated to GBP interest rates at **28 May 2021**, with stochastic risk premiums based upon a historical analysis of the following indices:
  - **Equity (50% allocation): 6%** to FTSE All Share; **44%** to MSCI World
  - **Bond (50% allocation): 22.5%** to 5-7 year GBP Corporates; **22.5%** to 10-year UK gilts; **5%** to GBP cash

Dynamic asset allocation:

- Future real-world projection scenarios were modelled based upon a calibration to the Milliman Managed Risk Parity Strategy, which is available through the Elston Dynamic Risk Parity Index (Bloomberg ticker ESBDRP Index). Further information is available at: www.elstonsolutions.co.uk/dynamic-risk-parity.html

For more detailed information on the assumptions, please contact Milliman

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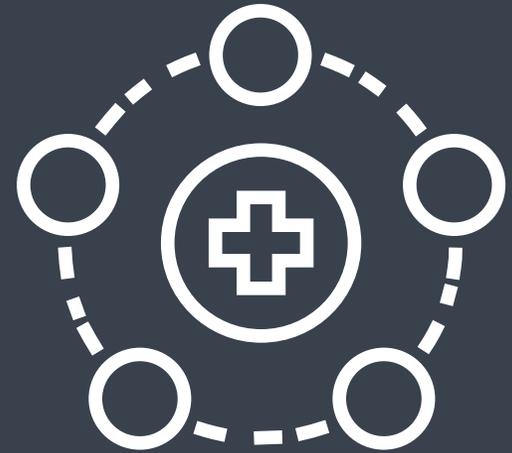# Life Insurance Stress Test 2022

Jessica Crowson, Florin Ginghina

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Agenda

This talk will cover two sections:

Section 1. An overview of the LIST 2022 exercise
(focusing on key complexities)

Section 2. Illustrative results
(using a model of a simplified life company writing BPA business)

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Section 1: Overview of LIST 2022

Introduction to LIST 2022

- The aim of the LIST 2022 exercise is to assess the resilience of large, annuity writing life insurers to a severe but plausible adverse scenario.

- LIST 2022 is expected to be launched in May 2022, for submission by September.

- The PRA launched the final request for technical input for LIST 2022 in January 2022; firms had until 17 March 2022 to provide responses.

- In this request for input, the PRA provided detail on the scenarios, together with the scenario calibration, specifications and guidance, a quantitative data template and requirements for the Results and Basis of Preparation ("RBP") report.

- The first LIST exercise was in 2019. LIST 2022 may be more onerous for firms due to the level of detail required.

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Overview of LIST 2022 requirements

The LIST 2022 stress consists of four stages, summarised in the table below:

		Stage 1 Initial Market Shock	Stage 2 Developing Market Shock	Stage 3 Protracted Market Shock	Stage 4 Protracted Market & Longevity Shock
Market stresses	Credit spreads	Between +115bps to +400bps A: +225bps BBB: +325bps	Between +100bps and +520bps A (Non-downgraded assets/Downgraded assets): +200bps/+295bps BBB (Non-downgraded assets/Downgraded assets): +240bps/+520bps		
	Corporate downgrades	No	30% 1CQS		
	Interest rates	-50bps			
	Equities	-33%			
	Property	-	-33%		
Counterparty defaults (including reinsurance)		No	30% 1CQS		
Longevity stress		No	No	No	+7.5% base table
Equity Release Mortgages		No	Internal ratings reassessed	Re-securitisation	Re-securitisation

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Management actions

- Certain management actions can be applied when assessing the impact of the shocks. Firms will need to determine the effectiveness and suitability of actions for use in the LIST 2022 exercise.

- The management actions must be in line with the time horizon of the relevant stress.

- Firms may wish to consider consistency with management actions assumed within the internal model (or internal stress and scenario testing for standard formula firms), and with other stress and scenario testing carried out within the business.

- The table on the next slide shows the permissibility of management actions at each stage, for a range of key management actions.

Management actions (cont'd)

	Stage 1 Initial Market Shock	Stage 2 Developing Market Shock	Stage 3 Protracted Market Shock	Stage 4 Protracted Market & Longevity Shock
Time horizon	**Day one**	**Within one month**	**Within one year**	
Use of pre-arranged external liquidity facilities	Permitted			
Inject assets in MA funds	Permitted			
External trading, including derivatives	Not permitted	Interest rate and inflation swaps only	Permitted (Liquid investments only)	
Restructure of ERM securitisations	Not permitted		Permitted	
New reinsurance	Not permitted			
Movement of assets within ring-fenced funds	Permitted			
Movement of assets between ring-fenced funds or ring-fenced funds and shareholder funds	Not permitted			

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Other key areas of complexity

Proxy modelling and approximations

- Several firms made use of proxy models and approximations in LIST 2019.

- Must be appropriate for the tail of the distribution used in the scenario.

- The use of simplifications should not affect the level of detail in the Results and Basis of Preparation report.

TMTP recalculation

- Firms may wish to confirm the approach to the Financial Resource Requirement limits.

- Is the level of TMTP in the LIST 2022 scenario affordable?

Other considerations

- Effective Value Test for ERMs: EVT recalculation in each of the four stages.

- Subordinated debt: revaluation approach and reassessment of tiering restrictions.

- Governance requirements: more stringent requirements vs. LIST 2019.

- Synergies with similar regulator led market risk sensitivities e.g. SS7/17.

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Section 2:
Illustrative results of the LIST 2022 exercise

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Setting the scene

Company profile	Key assumptions	Stage stresses

Company profile

- Annuity provider
- c180k policies, 90% in-payment and 10% deferred
- MA portfolio asset mix: gilts 15%, corporate bonds 50% and illiquid assets 35%
- SCR and buffer invested in gilts and corporate bonds and illiquid assets (75%/25%)
- Risk margin invested in gilts (net of TMTP)
- Tier 1/2/3: 80%/15%/5%

Key assumptions

- Market data and corporate spreads as at 31 December 2021
- Longevity assumptions in line with the market
- Standard Formula SCR
- TMTP 50% of Risk Margin
- PRA cashflow matching test 1 and 3 managed with some margins
- PRA cashflow matching test 2 not considered

Stage stresses

- Stage 1: Interest rate and spreads widening modelled
  - Interest rate and spread widening stresses in the 1-in-10 to 1-in-20 range
  - Although not modelled, the property stress is onerous (as extreme as a 1-in-1000 or more)
- Stage 2: Downgrades and spreads widening
  - 30% 1-notch downgrade is onerous
  - Sub-investment grade cap
  - Matching in the MA portfolio deteriorates
- Stage 3: No further stresses
- Stage 4: Longevity stress
  - -7.5% base mortality stress is onerous – likely more onerous than a 1-in-10 or 1-in-20
  - Matching in the MA portfolio further deteriorates

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Results – base

- BEL of c£50bln, invested in gilts, corporate bonds and illiquid assets

- SCR coverage ratio of 160%

- TMTP offset 50% of Risk Margin

- Negative reinsurance asset (reinsurance fees)

- SCR of c£2.7bln (Spread risk £2.0bln, Longevity risk £1.1bln, Interest rate risk £0.8bln)

- Liability and de-risked asset cash flows in the MA portfolio shown below:

— Liability cash flows   — Component A asset cash flows (post PD)

As at 31 December 2021 (£millions)	Base
Assets, of which:	**55,168**
Gilts	11,429
Corporate bonds	25,905
Illiquid assets	18,134
Liabilities, of which:	**50,919**
Best estimate liabilities (net of reinsurance)	49,929
Risk margin	1,250
TMTP	-625
Excess of assets over liabilities	**4,249**
Eligible own funds to meet the SCR	4,249
SCR	**2,655**
SCR coverage ratio	**160.0%**
Eligible own funds to meet the MCR	4,037
MCR (linear method & subject to the SCR corridor)	1,064
MCR coverage ratio	340%
MA portfolio metrics	
MA (bps) / sub-investment grade cap / FS (bps)	103 / n/a / 62
PRA matching test 1	2.0%
PRA matching test 3	99.6%

Results – all stages

Stage 1

- Solvency improves due to interest rate stress, partly offset by spread stress

Stage 2

- Solvency deteriorates, particularly due to the downgrade stress
- PRA matching test 3 fails
- Reductions in own funds and SCR trigger sub-debt tiering restrictions

Stage 3

- Management actions to improve solvency and matching:
  - Trade cash/gilts for liquid corporate bonds
  - Replace downgraded counterparties
  - Replace sub-investment grade assets with investment grade liquid corporate bonds
- These can improve solvency by up to 10-15%

Stage 4

- Solvency deteriorates further
- PRA matching test 3 fails by a greater margin

(£millions)	Base	Stage 1	Stage 2	Stage 3	Stage 4
Assets	55,168	44,763	44,507	44,507	45,480
Liabilities	50,919	42,058	42,386	42,386	43,663
Excess of assets over liabilities	**4,249**	**2,707**	**2,120**	**2,120**	**1,817**
Eligible own funds to meet the SCR	**4,249**	**2,684**	**2,120**	**2,120**	**1,805**
SCR	**2,655**	**1,654**	**1,722**	**1,722**	**1,677**
SCR coverage ratio	**160%**	**162%**	**123%**	**123%**	**108%**
MCR coverage ratio	340%	270%	184%	184%	148%
MA (bps) Sub-investment grade cap	**103** None	**311** None	**305** -12bps	**305** -12bps	**305** -12bps
PRA matching test 1	**2.0%**	**1.9%**	**2.7%**	**2.7%**	**2.9%**
PRA matching test 3 Injection required to restore to 99.0%, £m Injection required to restore to 99.6%, £m	**99.6%**	**99.6%**	**98.1%** +600 +950	**98.1%** +600 +950	**97.3%** +1,100 +1,450

Notes:

- *No management actions are modelled in any of the stages shown.*
- *No stresses are applied in Stage 3.*

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Summary and conclusions

- LIST 2022 calculations will be highly complex and intricate.

- The strength of some of the stresses will pose significant challenges in terms of the production and validation of results.

- Although stresses occur over a 12-month period, firms will only have specific management actions available to improve their solvency, liquidity and matching of MA portfolios.

- Participating firms should consider validating their approaches with regards to modelling, simplifications and management actions with the PRA.

- Management buy-in of results and management actions will be required to ensure sign off and timely submission.

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Appendix: company profile and assumptions

Economic data

- Market data as at 31 December 2021

- Selected corporate bond spreads:

Ratings	AAA	AA	A	BBB
Financial				
10 years	0.74%	0.91%	1.20%	1.82%
15 years	0.91%	1.16%	1.41%	2.11%
Non-Financial				
10 years	0.55%	0.67%	0.92%	1.56%
15 years	0.84%	1.07%	1.36%	2.13%

Longevity and reinsurance

- Benefits escalating with inflation, no spouse benefits

- Durations 15y in-payment and 20y deferred

- A-rated reinsurer, 80% reinsured in-payment, 50% reinsured deferred

Capital requirements

SCR

- Standard Formula SCR

- LACDT 15% of SCR before LACDT

MCR

- Linear MCR (2.1% of net BEL), and SCR corridors

TMTP

- 50% of Risk Margin, FRR not considered

MA portfolio

- All liabilities in the MA portfolio (no VA)

- Components A and B only (no assets in Component C)

- PRA cash flow test 1: 2%

- PRA cash flow test 3: 99.6%

- PRA cash flow test 2: not considered.

Asset mix

MA portfolio

- Gilts 15%

- Corporate bonds and illiquid assets:

Asset mix (non-gilts)	Financial	Non-Financial	Illiquid assets (non-financial)
AAA	1%	2%	-
AA	3%	5%	5%
A	9%	14%	25%
BBB	7%	11%	5%

- 50bps Illiquidity premium on illiquid assets

Risk margin: 50% gilts, 50% TMTP

SCR and excess assets: gilts, and corporate bonds and illiquid assets (75%/25%)

Tiering of capital resources

- Tier 1 / 2 / 3: 80% / 15% / 5%

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Operational Risk Modelling

Adél Drew

Tatiana Egoshina

MARCH 2022

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Agenda

- Industry Overview
- Typical modelling processes and issues faced
- Causal modelling
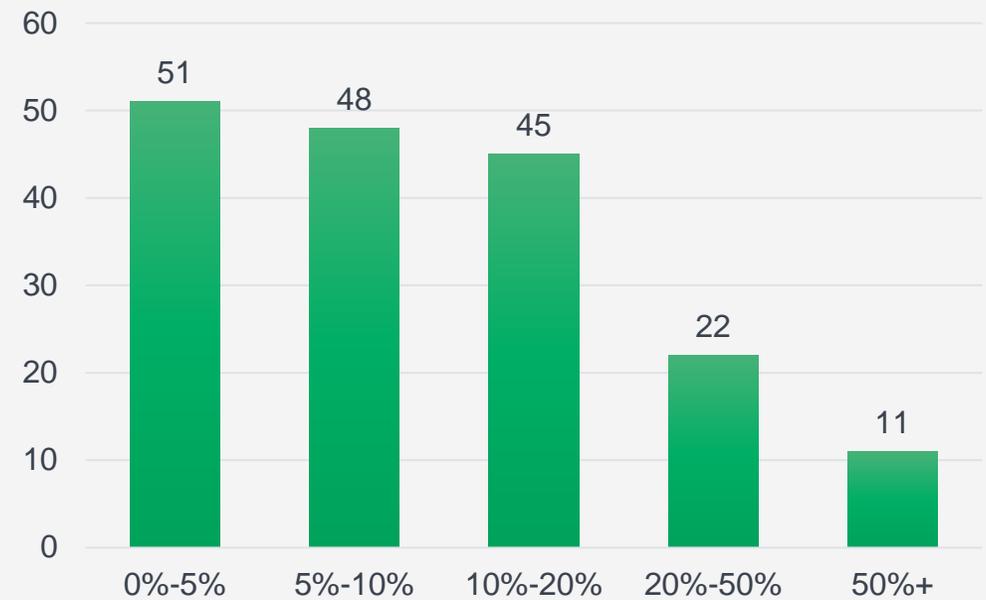- Other areas of development in operational risk modelling

Industry overview:

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Industry overview of SCR

Results for UK insurers in 2020

SCR MODEL TYPE BY INSURER CATEGORY

- Standard formula
- (Partial) Internal Model
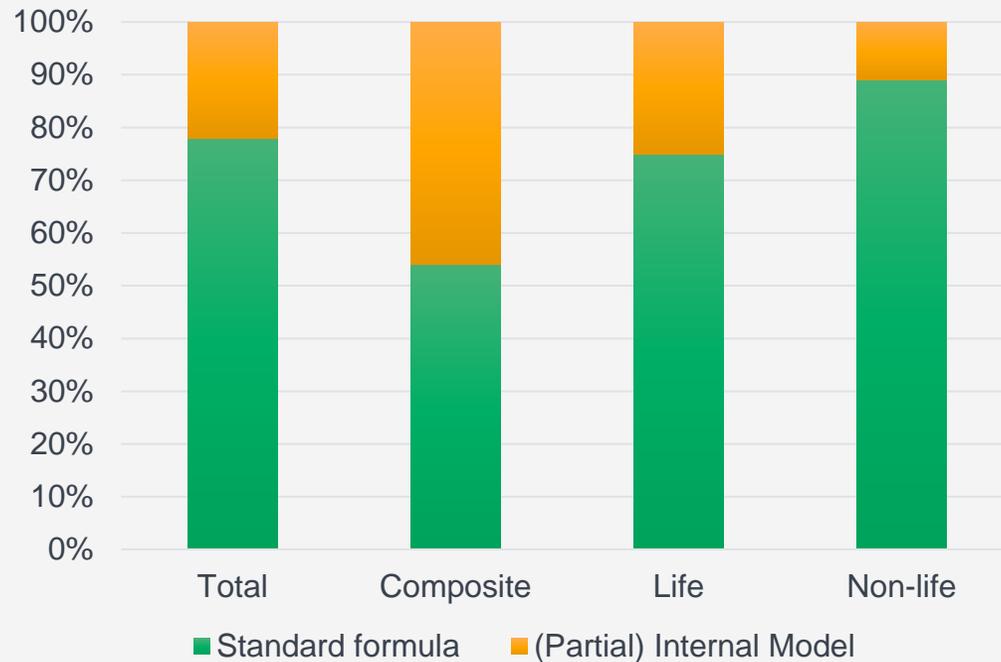
OPERATIONAL RISK SCR AS % OF TOTAL SCR BY COUNT

Range	Count
0%-5%	51
5%-10%	48
10%-20%	45
20%-50%	22
50%+	11

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ORIC Operational Risk Capital Benchmarking Survey

Responses from 24 participants across various locations in UK, Ireland, Holland, United States and Australia in 2020

OPERATIONAL RISK MODELLING APPROACH EMPLOYED BY FIRMS (N=20)

30%

70%

- Scenario-based Approach
- Hybrid Approach
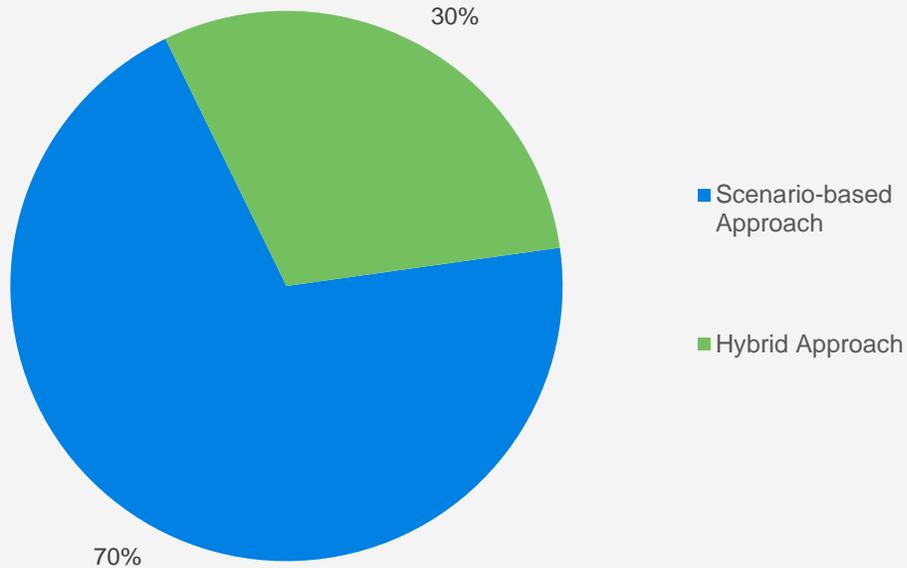
APPROACH EMPLOYED BY FIRMS IN OPERATIONAL RISK LOSS DISTRIBUTIONS (N=20)

10%

15%

75%

- Total Loss Distribution
- Frequency/Severity
- Other*

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Typical modelling processes and issues faced:

Typical Structure of Operational Risk Capital Model

Operational Risk Taxonomy
- Set of risk categories an organization is exposed to
- Typically includes categories such as Internal and External Fraud, Cyber Risk, People

Scenario Selection
- Driven by Risk Assessment/Risk Heatmap
- High level evaluation of risk exposure

Scenario calibration
- Calibration of Frequency and Severity distributions
- Derivation of Total Loss distribution for operational risk losses

Scenario Aggregation
- Dependency structure
- Correlation calibration
- Operational Risk capital calculation

Validation
- Validation of methodology and calibration
- Monitoring of continued appropriateness
- Use in decision making

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Risk Taxonomy and Scenario Selection

Wide range of operational activities: many different types of input resources, business lines, processes

- This could give rise to different types of operational events

- Aim is to segment losses into homogenous and mutually exclusive categories

- Granularity and hierarchy

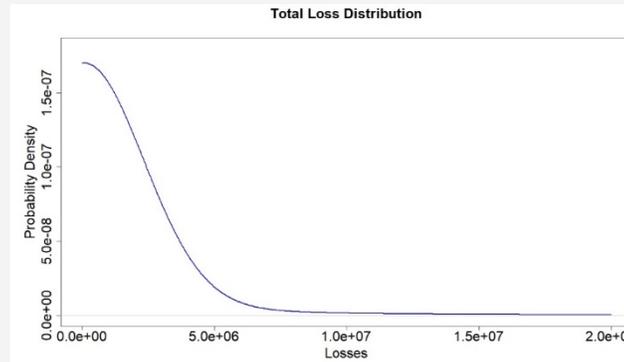# Scenario Calibration

Frequency and Severity model

Frequency of Events
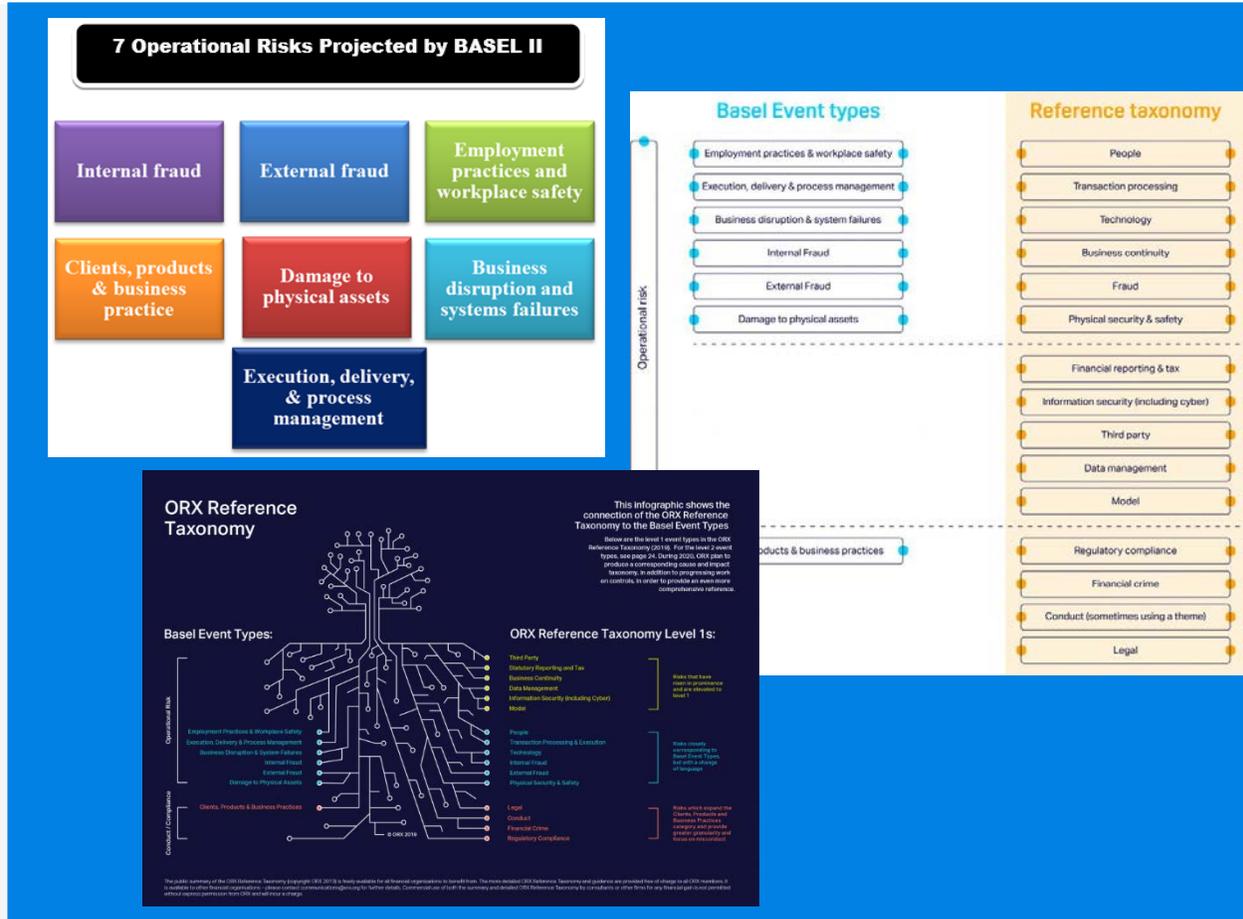
Individual Loss Distribution

$$\sum_{i=0}^{N} X_i$$
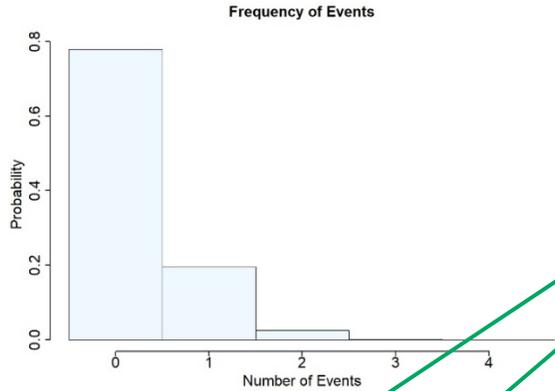
Total Loss Distribution
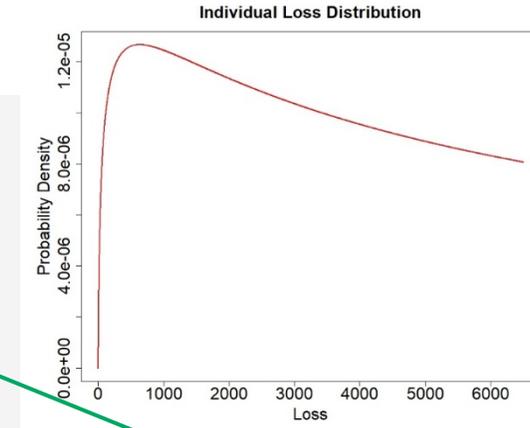
N: Frequency of Operational events

Typical distributions used:

- Poisson
- Negative Binomial

X_i *- Loss distribution of individual losses, when operational event happens*

Typical distributions used:

- LogNormal
- Weibull
- Generalized Pareto (GP Distribution)
- Log-logistic

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Scenario Calibration

Data

Company can consider that it has enough of internal data for one of the sub-risks, e.g. model risk

Key things to watch out for:

- How does the risk respond to business growth? (Not necessarily linearly!)

- How does it respond to other changes in risk profile – control improvements/implementation of new reporting systems/new reporting metrics/new products

- Internal records of operational event capture what's being modelled?

- Data credibility – do you have enough data to fit the distribution with confidence?

Individual Loss Distribution

Risk - level 1	Date occurred	Date reported		
Model Risk	01/10/2015	26/10/2015		
Cyber Risk	31/05/2016	25/06/2016		
Model Risk	02/07/2018	27/07/2018		
Model Risk	18/04/2021	13/05/2021	25,897,456	xxx
Model Risk	01/10/2015	26/10/2015	1,000,000	xxx
Cyber Risk	31/05/2016	25/06/2016	5,239,123	xxx
Model Risk	02/07/2018	27/07/2018	16,527,489	xxx
Model Risk	18/04/2021	13/05/2021	25,897,456	xxx

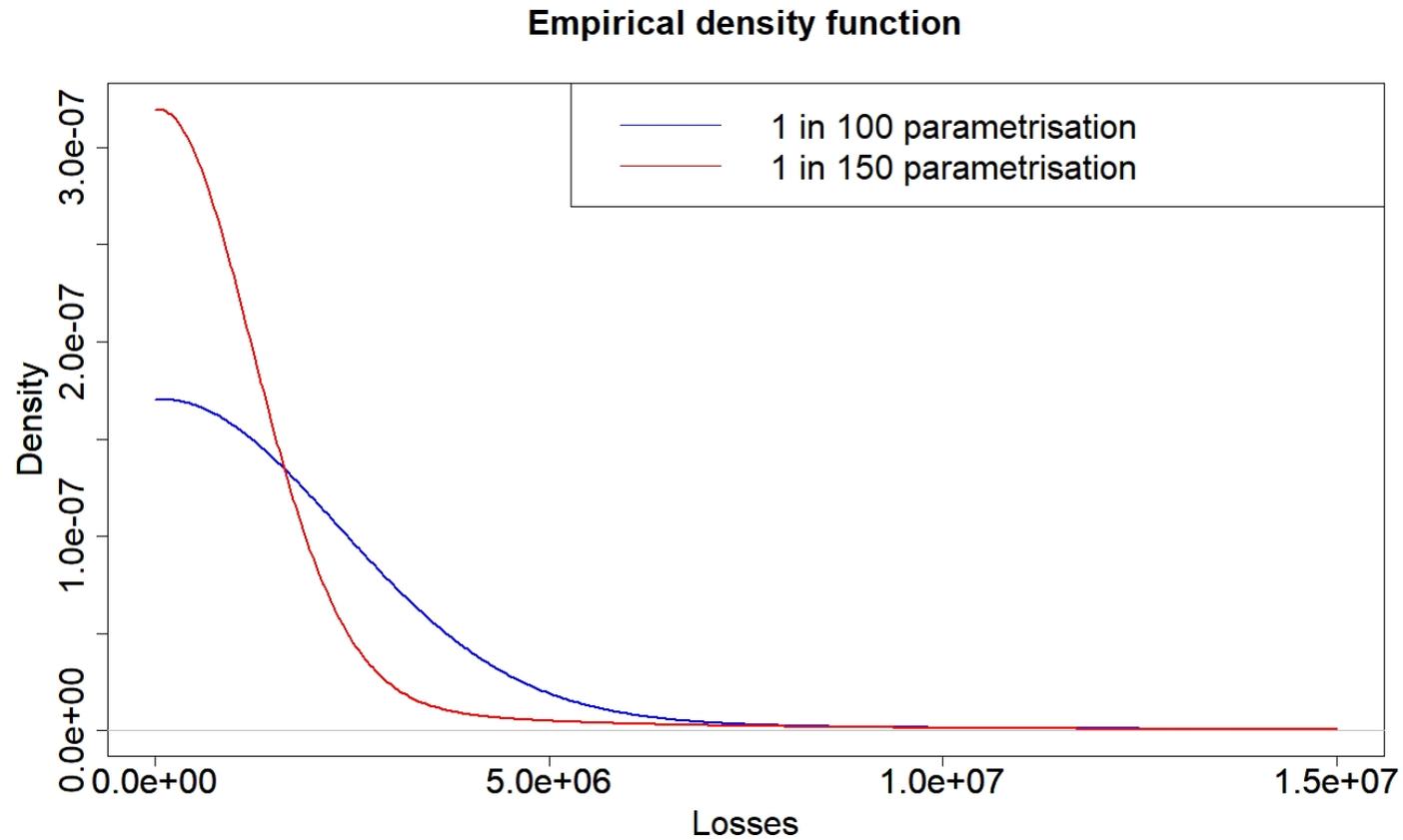Milliman
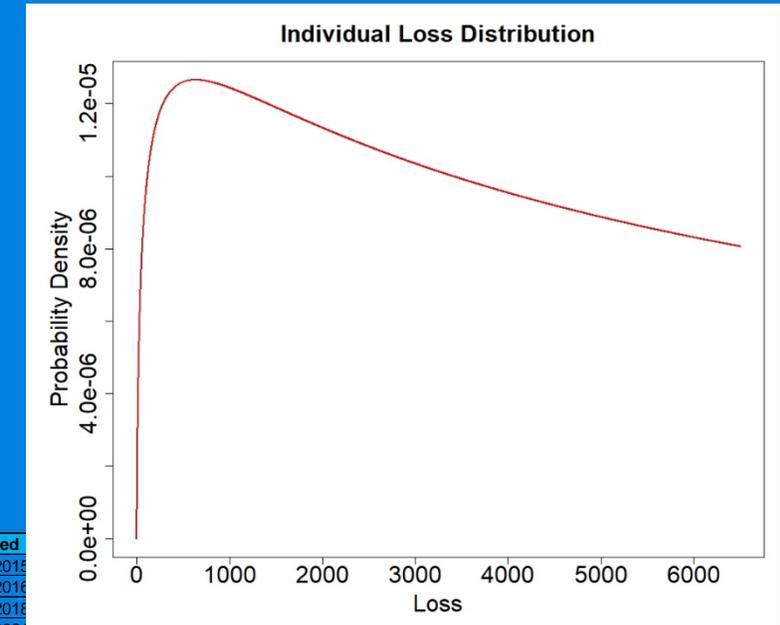
Scenario Calibration

Expert judgement calibration

- Workshops with SMEs – discussions to come up with plausible scenarios for:
  - Typical Case (TC) of risk manifestation – quantitative estimate of TC will be used as a mean/median of calibrated distribution
  - Worst Case of risk manifestation and the estimate of 'how bad the case is' - 1-in-150? 1-in-100?
  - The estimates from the workshops will be used for calibrating the distribution

- Key things to watch out for:
  - Typical case and worst case should make reference to the control and mitigation environment and its development
  - People are not very good at judging probabilities
  - Distribution choice is fairly arbitrary

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Scenario Calibration

Case Study

Empirical density function

Legend:
- 1 in 100 parametrisation
- 1 in 150 parametrisation

- Worst Case as 1-in-100 vs Worst Case as 1-in-150
- Capital: £41.4m vs £30.5m

Scenario Calibration

Frequency and Severity model – independence of Frequency and Severity

- Frequency and Severity are typically assumed to be independent

- It does not always quite bear in practice
  - Increased frequency of events might lead to higher severity
  - Cyber risk scenarios – often start with 'probing' (non-extensive attacks to explore vulnerabilities – small losses) to follow by an extensive attack with high loss

- Different techniques exist to allow for dependence between frequency and severity

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Practical considerations

- Frequency of calibration
  - Lengthy process so cannot be too frequent; too infrequent – will not reflect rapidly changing operational risk environment
- Validation of Operational Risk model
  - The model and calibration are expected to rely a lot on expert judgement – it is not easy to validate
  - Might not always be easy to conform to independence of calibration and validation
  - Calibration is a lengthy process and so is the validation!
  - New validation tools might needed to be developed

Conclusion

Short comings of frequency-severity for operational risk modelling

Expert Judgement

The way expert judgement is incorporated results in an educated guess at the operational risk figure and not necessarily reflective of the company's actual risk profile. It can also allow bias to influence results.

Aggregation

The technique requires breaking the larger problem down into smaller buckets and adding them back up again missing interactions and aggregations across buckets, and requiring further expert judgement

Static

Development and calibration of a frequency-severity model is a lengthy process and results in a static structure which cannot easily keep up with the rapidly changing business environment

Data / Choice of parameters

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Causal modelling:
An alternative to frequency-severity modelling

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Traditional approach vs causal modelling

Consider a simplified example
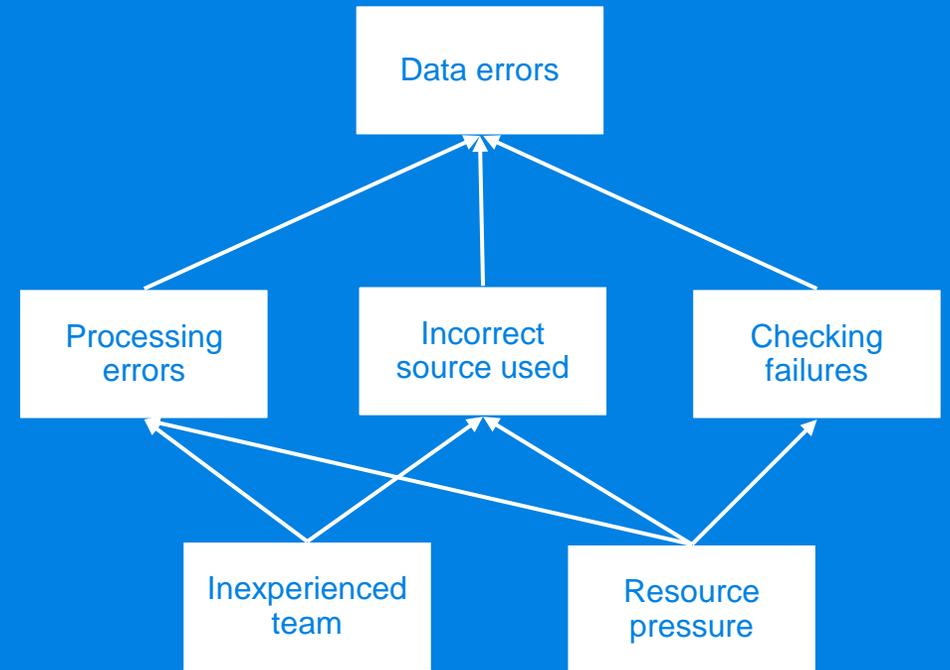
A causal model

Set observation of outcome

Reverse stress testing

What would that scenario look like for my causal factors?

Outcome

Nodes – Causal Factors

Triggers

What happens to my estimated loss?

Scenario analysis

Set observation of causal factor(s)

Other areas of development in operational risk modelling:

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Other areas of development in operational risk modelling

1

Operational resilience

- Operational resilience is indifferent to likelihood. However, consider:
  - What can be learnt about your operational risks from your operational resilience exercises
  - How your operational risk framework can provide a head start in considering operational resilience requirements

2

External data

- Several external data providers exist for operational risk
- However, bear in mind how your risk landscapes are changing and the relevance of past data
  - Climate
  - Cyber

3

Insurance recoveries

- Allowance for insurance recoveries within operational risk models

4

Dependencies

- Operational risks are becoming more correlated with non-operational risks
  - How to allow for dependencies across operational and non-operational risk categories

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Thank you

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