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How sub-optimal are age-based life-cycle investment products?

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Overview

Objective:

- Examine extent to which deterministic age-based life-cycle strategies are ‘near enough’ to optimal
- Two dimensions considered:
  - Glide path, benchmarked against optimal dynamic strategy
  - Risk aversion assumption underpinning the glide path

Findings:

1. Risk aversion matters – a lot
2. Failing to alter the glide path in response to return realisations also leads to a loss of utility, but it is more moderate
3. Glide path can be improved by basing it on projected balance

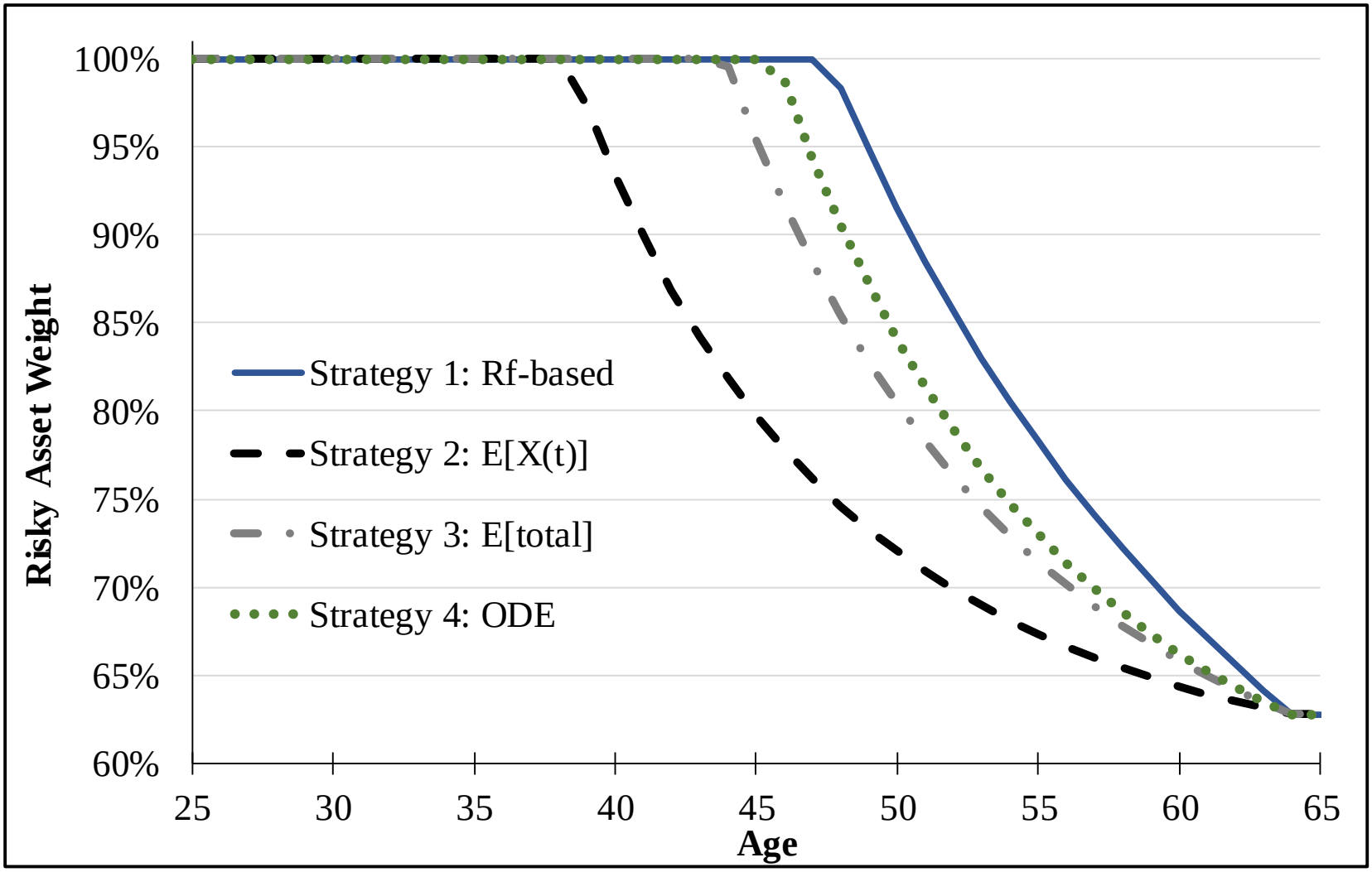
Strategies examined (1)

Strategy group	Description	Notes
Optimal: dynamic, the benchmark	$\pi(t) = \frac{1}{\gamma}\frac{\alpha - r}{\sigma^2}\frac{X^{\pi}(t) + h(t)}{X^{\pi}(t)}$ α, σ, r are E(Re), SD(Re), Rf γ is coefficient of rel. risk aversion (CRRA) $X^{\pi}(t)$ is the account balance $h(t)$ is PV of future contributions	• Merton (1971) • Income and hence contributions treated as deterministic • PV of contributions declines over time, implying decrease in risky asset weight
Proposed strategies	Based on projected balance assuming: 1. Invests in risk-free asset 2. Risky asset return equals its expected value 3. Expectation taken of total wealth 4. Ordinary differential equation	All strategies give rise to deterministic glide paths, formed with reference to projection for balance and hence wealth

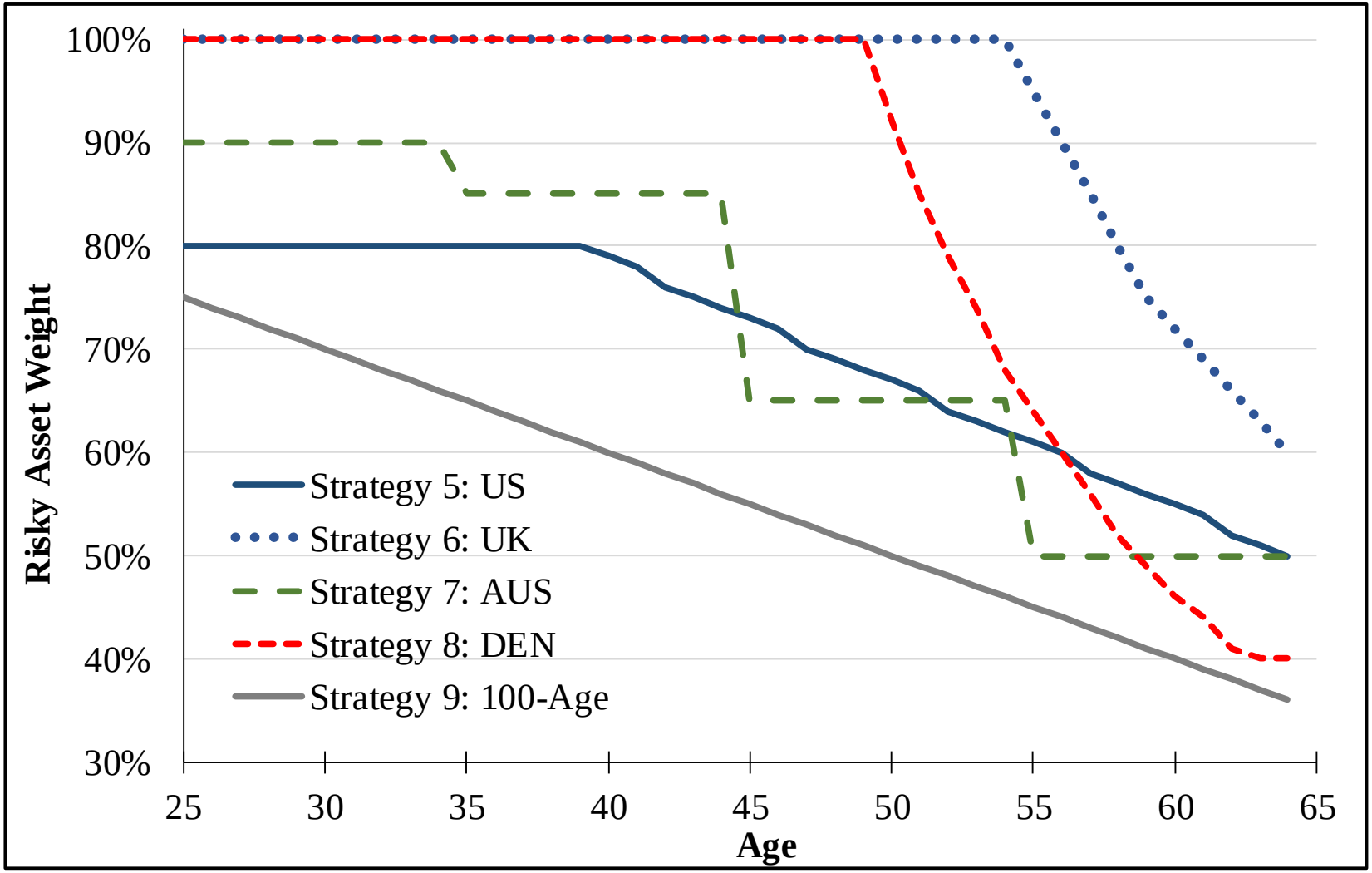
Strategies examined (2)

Strategy group	Description	Notes
Real life-cycle products	5. US – Vanguard 6. UK – Sky Pension Plan 7. Australia – Commonwealth Super 8. Denmark – PFA plus Pension Plan 9. 100 – Age (rule of thumb)	• Variation in glide paths across sample • Ordered by average growth asset weight: a. UK (94%) b. Denmark (85%) c. Australia (73%) d. US (70%) e. Age – 100 (56%)
Constant weight strategies	10. Balanced 60/40 11. Risky asset 100% 12. Risk-free asset 100%	Traditional balanced mix, plus the two 'book-end' weights

Glide paths for proposed strategies



Glide paths for real strategies



Modelling – A basic set-up

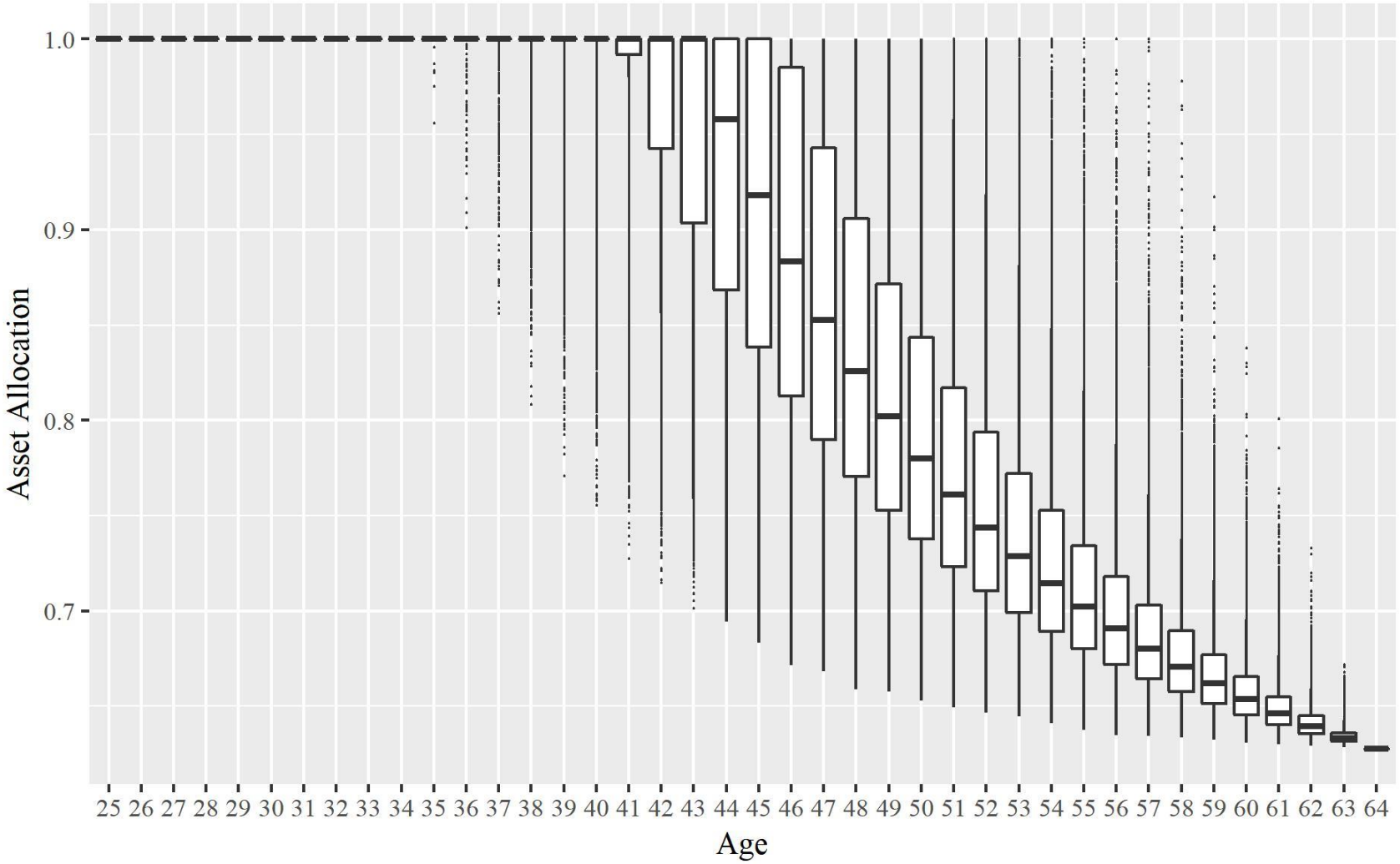
Assumptions:

- Investor starts working at age 25, retires at age 65
- Constant salary of $50,000, contribution rate of 10%
- α = 6.5%, σ = 17.4% and r = 0.8% (historical real returns)
- No taxes and social security
- Simulate 20,000 asset return paths; numerical approach

Outcomes and their evaluation:

- Balance at retirement
- Evaluated using power utility function, CRRA range 2 to 5
- Metrics:
  - Summary statistics for distribution of balance at retirement
  - Certainty equivalents – balance at retirement; extra required

Optimal benchmark strategy (CRRA =3)



Certainty equivalents – Initial Analysis

(Optimal – Strategy) / Income = 'years of income lost'

(Optimal - Strategy) / Income		Certainy Equivalent Balance at Retirement				Extra Starting Balance Required			
CRRA:		**2**	**3**	**4**	**5**	**2**	**3**	**4**	**5**
Proposed Strategies									
1	Rf-based	0.00	0.04	0.04	0.03	0.00	0.01	0.01	0.01
2	E[X(t)]	0.00	0.07	0.07	0.06	0.00	0.02	0.02	0.02
3	E[total]	0.00	0.02	0.03	0.03	0.00	0.01	0.01	0.01
4	ODE	0.00	0.02	0.03	0.03	0.00	0.01	0.01	0.01
Real Strategies									
5	US	1.32	0.34	0.17	0.27	0.31	0.10	0.06	0.11
6	UK	0.13	0.16	0.63	1.10	0.02	0.05	0.26	0.67
7	AUS	1.29	0.29	0.10	0.19	0.29	0.08	0.04	0.08
8	DEN	0.67	0.13	0.23	0.48	0.14	0.04	0.08	0.24
9	100-Age	2.41	0.93	0.37	0.17	0.67	0.29	0.13	0.07
Constant Weights									
10	60/40	1.88	0.70	0.40	0.41	0.50	0.22	0.14	0.17
11	Risky 100%	0.01	0.49	1.21	1.82	0.00	0.15	0.59	1.43
12	Rf 100%	5.75	3.80	2.80	2.21	4.18	2.76	2.04	1.61

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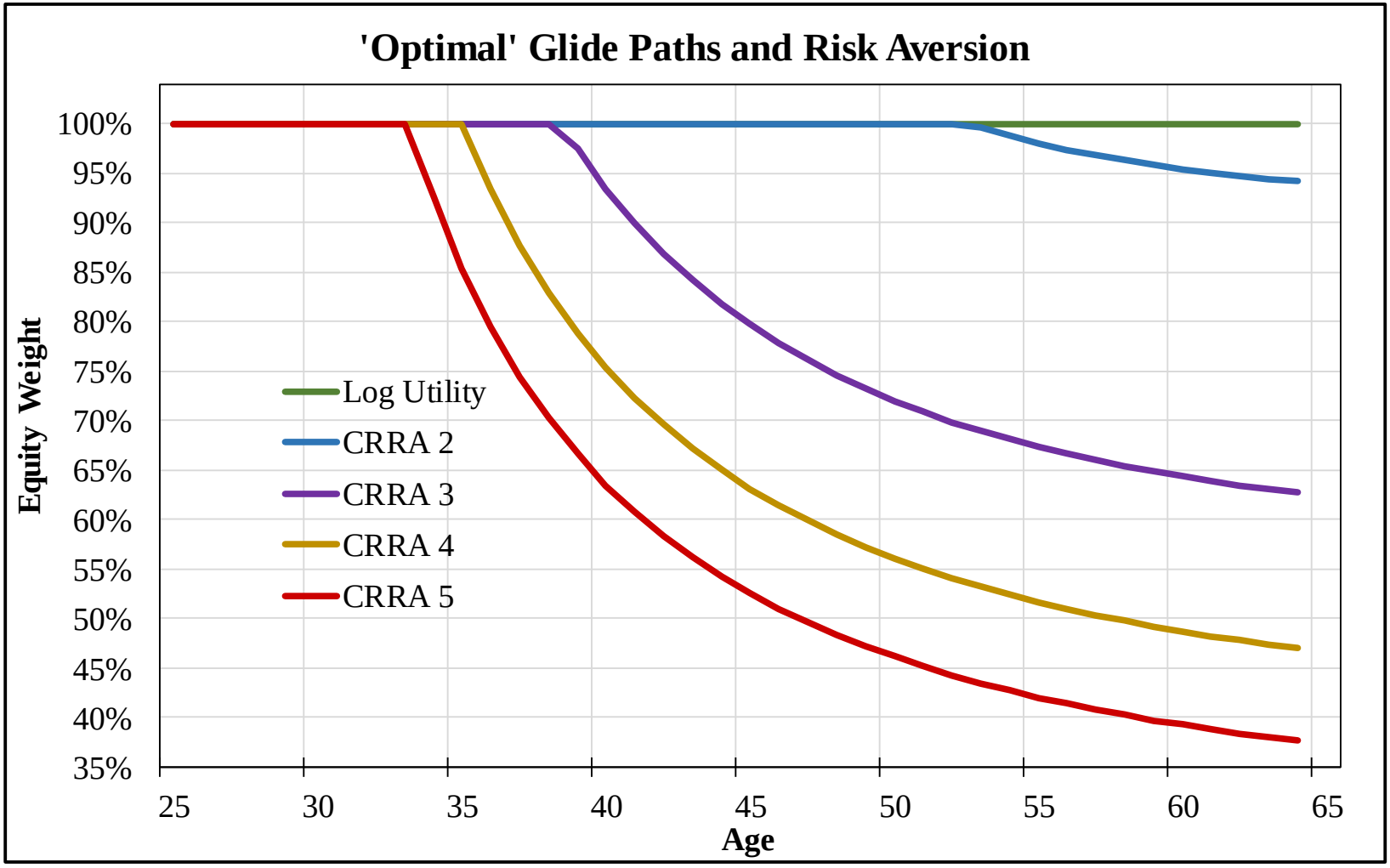
Certainty equivalents – Proposed strats re-examined

(Optimal – Strategy) / Income = 'years of income lost'

(Optimal - Strategy) / Income	Certainy Equivalent Balance at Retirement				Extra Starting Balance Required			
Evaluated at CRRA of:	**2**	**3**	**4**	**5**	**2**	**3**	**4**	**5**
	0.00	0.45	1.16	1.75	0.00	0.14	0.55	1.34
Asset Weights	0.00	0.39	1.06	1.65	0.00	0.12	0.49	1.21
Specified at CRRA = 2	0.00	0.44	1.13	1.73	0.00	0.13	0.54	1.31
	0.00	0.43	1.12	1.71	0.00	0.13	0.53	1.29
	0.29	0.04	0.34	0.73	0.06	0.01	0.13	0.39
Asset Weights	0.71	0.07	0.13	0.39	0.15	0.02	0.05	0.18
Specified at CRRA = 3	0.46	0.02	0.21	0.55	0.09	0.01	0.08	0.27
	0.40	0.02	0.25	0.60	0.08	0.01	0.09	0.30
	0.96	0.13	0.04	0.19	0.21	0.04	0.01	0.08
Asset Weights	1.54	0.38	0.07	0.07	0.36	0.11	0.02	0.03
Specified at CRRA = 4	1.25	0.24	0.03	0.10	0.28	0.07	0.01	0.04
	1.09	0.18	0.03	0.15	0.24	0.05	0.01	0.06
	1.63	0.43	0.08	0.03	0.38	0.12	0.03	0.01
Asset Weights	2.19	0.76	0.23	0.06	0.56	0.22	0.08	0.02
Specified at CRRA = 5	1.93	0.60	0.15	0.03	0.47	0.17	0.05	0.01
	1.94	0.60	0.15	0.03	0.47	0.17	0.05	0.01

Optimal glide paths and CRRA: A ‘level’ matter



Two ‘big’ caveats

1. **Other assets** may significantly alter the solution, in particular:
   - Pension – low-risk, hedging asset
   - Family home – substantial and advantaged asset

2. **Evaluating balance at retirement using power utility** imposes a particular view about member objectives. Other possibilities:
   - Post-retirement outcomes – income, bequest
   - Shorter-term balance as a point of focus
   - Reference dependent utility function

Conclusions and implications

1. Aligning a product's underlying CRRA assumption with investor risk aversion is CRUCIAL!
   - Utility loss can be substantial if this is out-of-kilter
   - Warning against one-size-fits-all strategies
   - Conservative => high growth options are offered in the 'balanced' fund arena. Why not the same in life-cycle?
2. Applying a deterministic rather than dynamic glide path can also lead to utility loss, but it is more moderate.
3. Scope exists for improving the design of deterministic life-cycle strategies by applying one of our proposed strategies.

Questions?

Discussion?