ACTUARIAL SOCIETY OF SOUTH AFRICA

QUANTIFYING RISK, ENABLING OPPORTUNITY

AGENDA

- What does LDI & liability matching mean for DC?
- Comparison of member liabilities
  - Does LDI need to be deployed at an individual level?
- Efficacy of LDI usage in DC
- Conclusions & other considerations

WHAT IS LIABILITY MATCHING?

WHAT IS LDI FOR DC?

- LDI looks holistically at structuring investments to best meet objectives
- Includes sufficient growth
- Maximisation of expected utility = LDI for DC

Reading on utility optimisation:

Blake, Cairns & Dowd (2005), "*Stochastic Lifestyling: Optimal Dynamic Asset Allocation for Defined Contribution Pension Plans*"

Thomson (2003), *"The Use of Utility Functions for Investment Channel Choice"*,

Emms (2010), "*Lifetime investment and consumption using a defined-contribution pension scheme*"

Demster & Medova (2010), *"Asset liability management for individual households"*

WHAT IS LIABILITY MATCHING?

- For the purposes of this presentation
  - Zero or near zero risk
  - Tracking or matching of a liability (cash flows)
  - *"LDI Asset Managers"* and other matching products
  - Offer matching or tracking solutions

Publically available reading on matching techniques & comparisons:

Ho, T. (1992), *"Key Rate Duration Measures of Interest Rate Risk"*

Reitano, R. (1991), *"Multivariate Duration Analysis"*

Reitano, R. (1991), *"Multivariate Immunization Theory"*

Reitano, R. (1992), *"Non-Parallel Yield Curve Shifts and Immunization"*

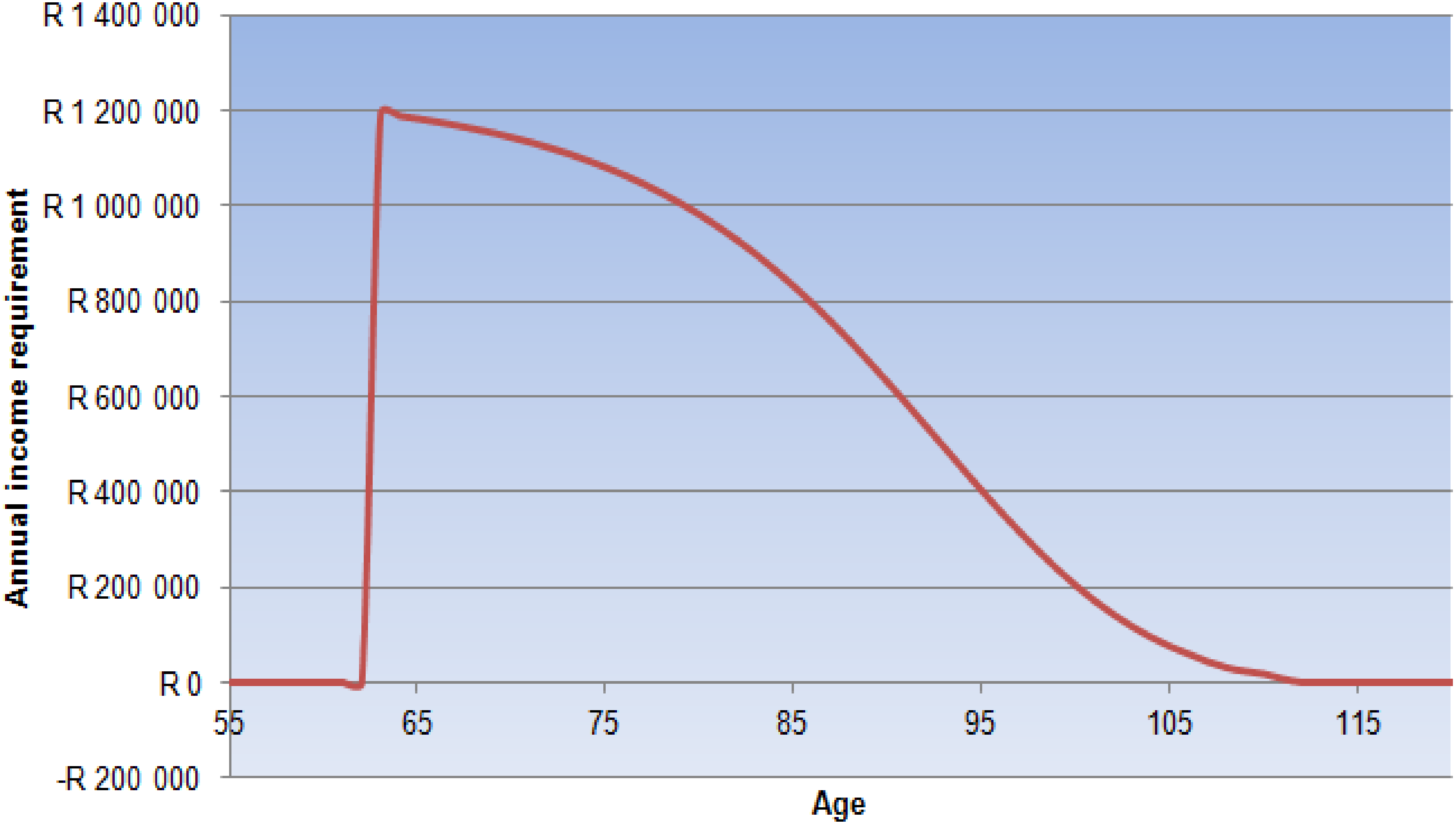
Coleman (2011) *"A Guide to Duration, DV01, and Yield Curve Risk Transformations"*

WHAT IS A DC LIABILITY

WHAT IS A DC LIABILITY?

- Risk free objective is a stable, inflation-linked income
- Match for an inflation-linked annuity purchase is hence risk free asset for DC members
- Matching portfolios may hence have a role to play in low risk *portion* of DC LDI spectrum
- This may become more even more important if forced partial or complete annuitisation is introduced
    - More generally, NT appears keen to take steps to secure *incomes* for pensioners

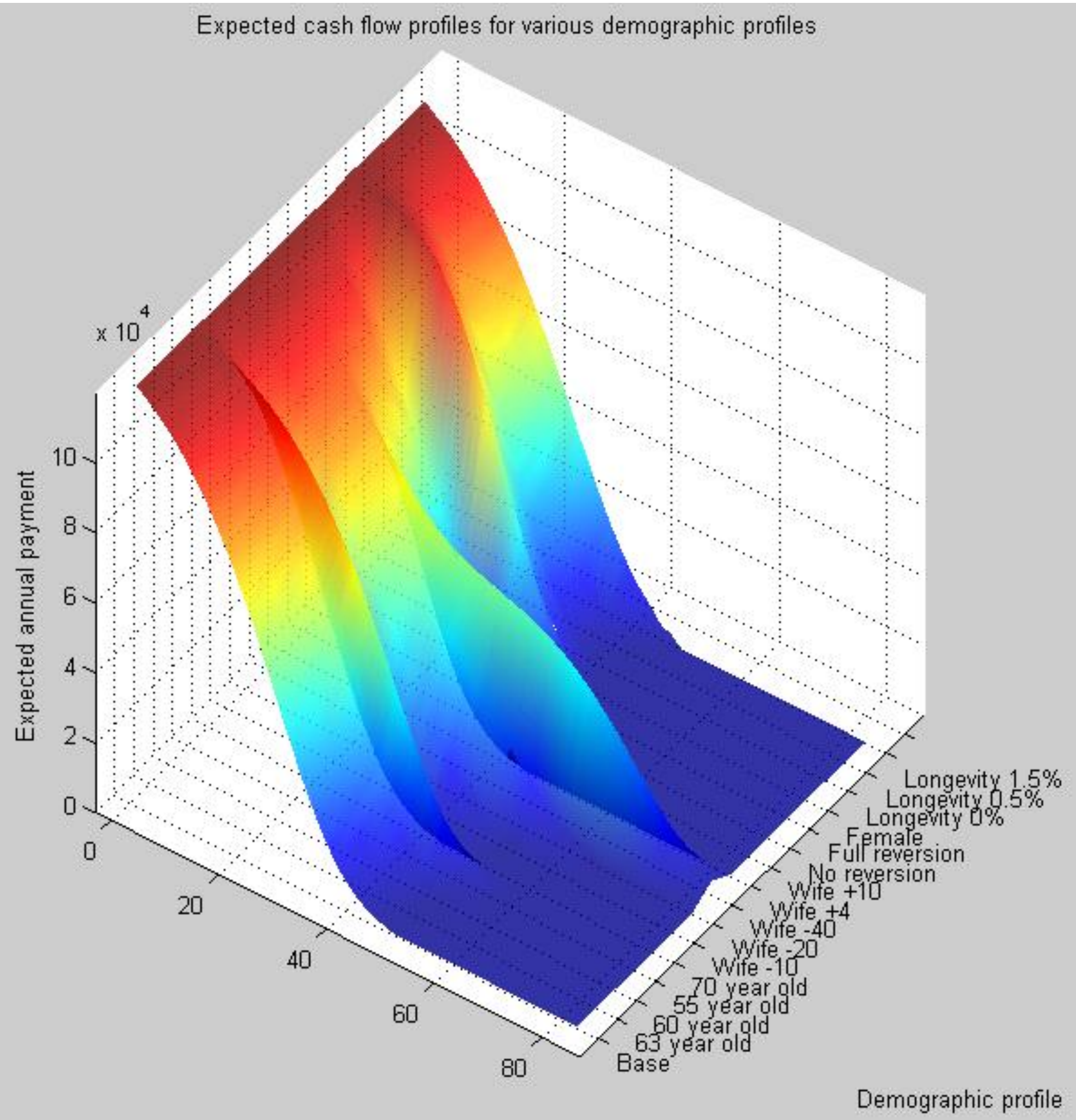
Expected cash flows



HOW DO MEMBER LIABILITIES VARY?

PROFILES TESTED

AGE	SPOUSE'S AGE	SEX	REVERSION	Mortality	Mort Impr
65	61	M	50%	PA(90)-2	1%
63	59	M	50%	PA(90)-2	1%
60	56	M	50%	PA(90)-2	1%
55	51	M	50%	PA(90)-2	1%
70	66	M	50%	PA(90)-2	1%
65	55	M	50%	PA(90)-2	1%
65	45	M	50%	PA(90)-2	1%
65	25	M	50%	PA(90)-2	1%
65	69	M	50%	PA(90)-2	1%
65	75	M	50%	PA(90)-2	1%
65	61	M	0%	PA(90)-2	1%
65	61	M	100%	PA(90)-2	1%
65	69	F	50%	PA(90)-2	1%
65	61	M	50%	PA(90)-2	0.0%
65	61	M	50%	PA(90)-2	0.5%
65	61	M	50%	PA(90)-2	1.5%
63	59	M	75%	PA(90)-2	1%

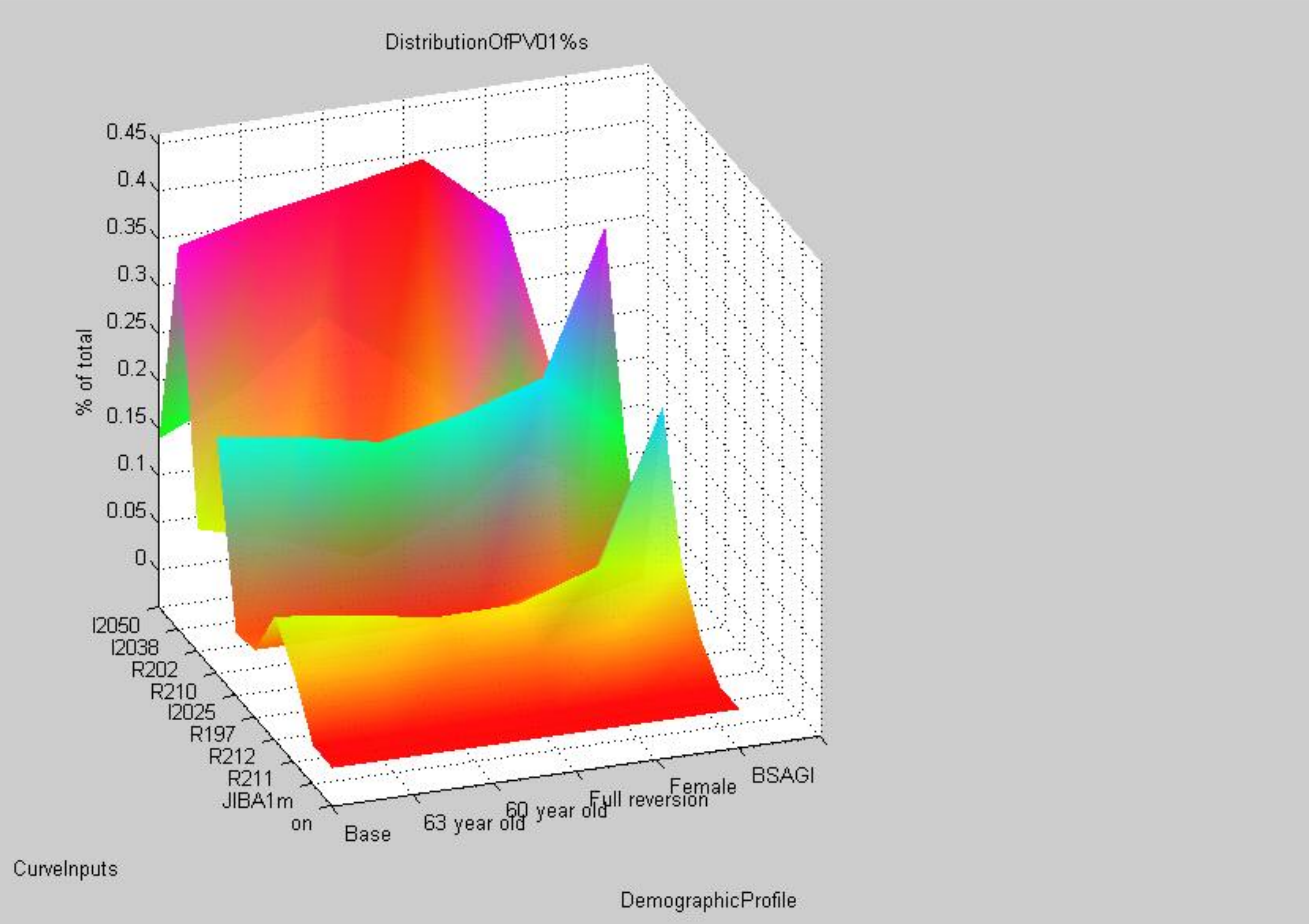

Expected cash flow profiles for various demographic profiles
x 10^4
Expected annual payment
0
2
4
6
8
10
0
20
40
60
80
Longevity 1.5%
Longevity 0.5%
Longevity 0%
Female
Full reversion
No reversion
Wife +10
Wife +4
Wife -40
Wife -20
Wife -10
70 year old
55 year old
60 year old
63 year old
Base
Demographic profile

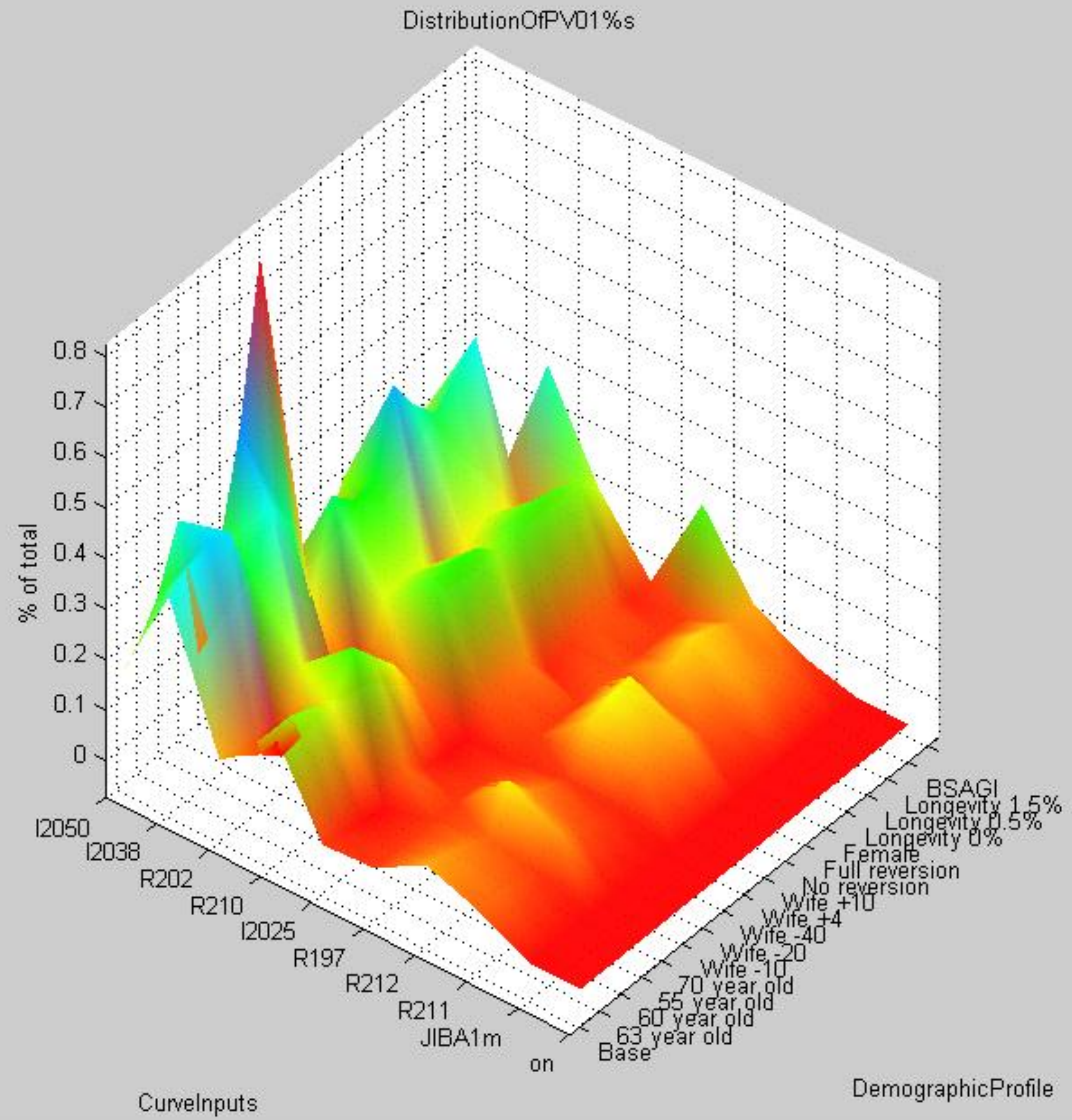
TESTING DIFFERENCES IN PROFILES

- Consider how similar perfect hedges for various profiles would be
- Look at partial durations (DV01) measured with regard to curve input instruments
    - Testing how much the liability present value changes for 0.01% changes in the various market bond yields
    - Really just a way to describe the characteristics of a liability's sensitivities to the yield curve
    - Two liabilities with identical distributions of DV01s could be hedged using same building blocks

Comparison of different sensitivities:

Coleman (2011) *"A Guide to Duration, DV01, and Yield Curve Risk Transformations"*


DistributionOfPV01%s
% of total
0.45
0.4
0.35
0.3
0.25
0.2
0.15
0.1
0.05
0
I2050
I2038
R202
R210
I2025
R197
R212
R211
JIBA1m
on
CurveInputs
Base
63 year old
60 year old
Full reversion
Female
BSAGI
DemographicProfile


DistributionOfPV01%s
% of total
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
I2050
I2038
R202
R210
I2025
R197
R212
R211
JIBA1m
on
CurveInputs
BSAGI
Longevity 1.5%
Longevity 0.5%
Longevity 0%
Female
Full reversion
No reversion
Wife +10
Wife +4
Wife -40
Wife -20
Wife -10
70 year old
55 year old
60 year old
63 year old
Base
DemographicProfile

EFFECT OF USING MATCHING

MODELLING

- Maitland Stochastic Asset Model

- Model replacement ratio
  - At retirement
  - Ten years from now

- Consider risk metrics and expectation

- Model limitation-does not generate a full yield curve, hence volatility (and benefit of matching) is marginally underestimated

EFFECT OF DIFFERENT DE-RISKING ASSETS

	ILBs	Matching
Standard Deviation	5%	0%
5th Percentile	89%	100%
20th Percentile	93%	100%
P < 100%	65%	1%
P < 90%	7%	0%
P < 80%	0%	0%
P < 70%	0%	0%
P < 60%	0%	0%
Mean	98%	100%

63 year old male, 59 year old spouse, 75% spouse's reversion, PA90-2, 1% improvement per annum

EFFECT OF DIFFERENT DE-RISKING ASSETS

	Diversified life staging-cash and bonds	Diversified life staging-matching
Standard Deviation	44%	42%
5th Percentile	65%	67%
20th Percentile	86%	87%
P < 100%	35%	34%
P < 90%	24%	23%
P < 80%	15%	14%
P < 70%	8%	7%
P < 60%	3%	2%
Kurtosis	262%	256%
Mean	122%	121%

63 year old male, 59 year old spouse, 75% spouse's reversion, PA90-2, 1% improvement per annum

EFFECT OF DIFFERENT DE-RISKING ASSETS

	Diversified life staging	Diversified life staging (Sub LDI)	Diversified life staging (Sub Cash)
Standard Deviation	44%	42%	45%
5^{th} Percentile	65%	67%	63%
20^{th} Percentile	86%	87%	84%
P < 100%	35%	34%	36%
P < 90%	24%	23%	25%
P < 80%	15%	14%	16%
P < 70%	8%	7%	9%
P < 60%	3%	2%	4%
Mean	122%	121%	121%

63 year old male, 59 year old spouse, 75% spouse's reversion, PA90-2, 1% improvement per annum

LONGER DURATION PROFILES

	Life staging – matching assets	Life staging – bonds, cash
Standard Deviation	47%	54%
5th Percentile	61%	53%
P < 100%	38%	39%
P < 90%	28%	31%
P < 80%	18%	22%
P < 70%	10%	14%
P < 60%	5%	8%
P < 50%	1.5%	3.8%

65 year old male, 25 year old spouse, 50% spouse's reversion, PA90-2, 1% improvement per annum

COMMENTS & CONCLUSIONS

- Unlikely that individual solutions will be possible in immediate future
- Proxy profile could work
    - Vast majority of members (core profiles), would be well suited
    - Longer duration profiles more poorly suited
    - Proxy would still be a closer match than market indices
- LDI mandates currently cheaper than specialist fixed income
- Added *technical* complexity for trustees and members; is this justified by the marginal gain?....
- …Conceptually the idea of targeting a liability is intuitive?

COMMENTS & CONCLUSIONS

- Regulation 28 requires liability focus

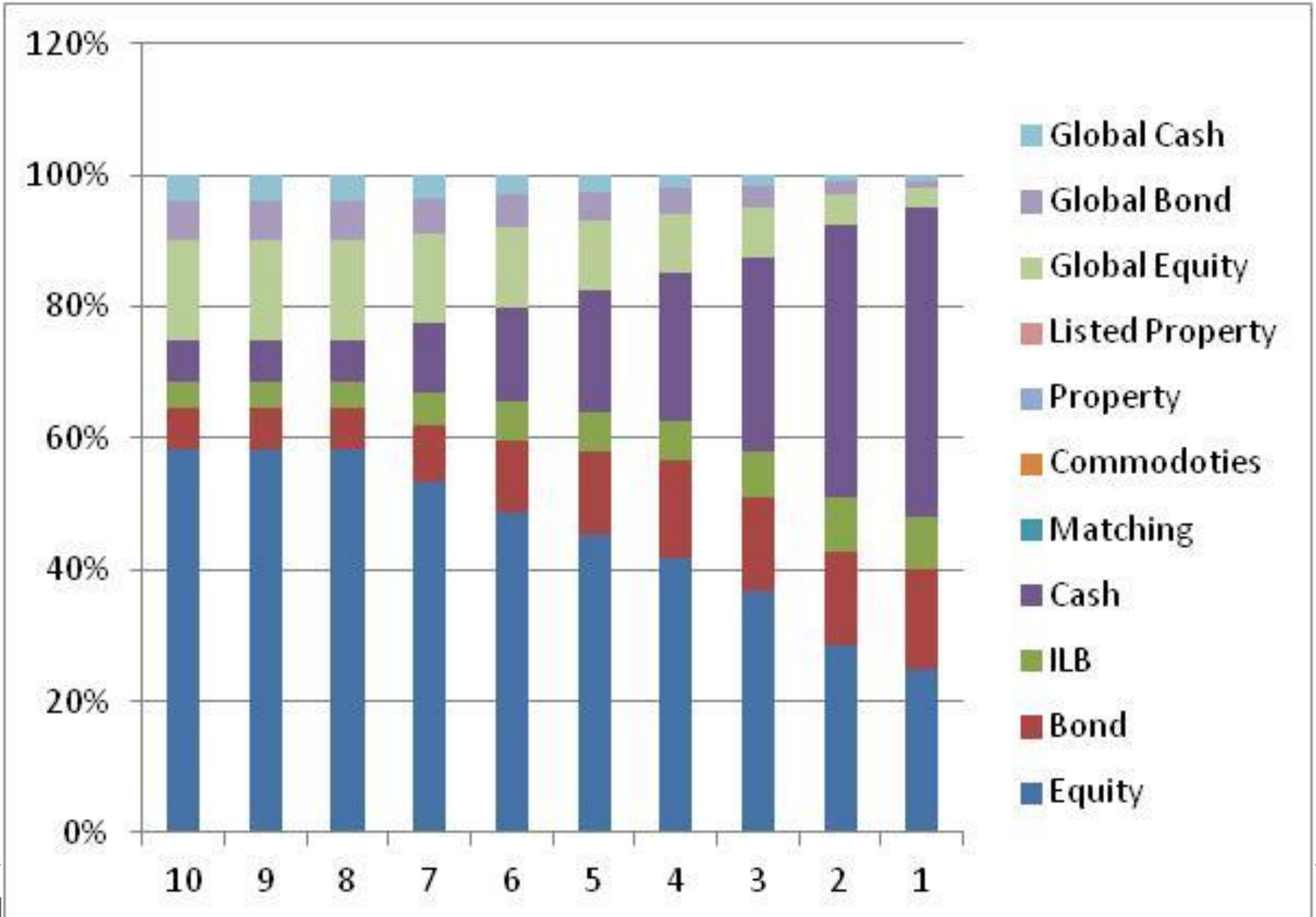
- Potential for more advanced deployments
    - Hedging basis for more sophisticated offerings
    - Including in-fund solutions such as existing pensioner pool, DB arrangements
    - Such as variations of inflation targeting annuities, which retain some market risk for affordability

APPENDIX

WHAT ABOUT ANNUITISATION CHOICES?

- A member's need is not an annuity, it is an income
- Hedging instrument hence addresses income requirement, not vehicle type
- How does this apply to With Profit Annuities?
  - Specific WPA category pricing does not vary frequently with markets
  - E.g. an 8% WPA is priced at a discount rate of 8%
  - Which category one targets varies with time, and is LINKED TO VARIATIONS IN EXPECTED RETURNS
  - for example, no one sells 8% categories anymore, as one needs a 1-2% category to have a reasonable chance of inflationary increases
  - Accounting for this variation is very similar to hedging an inflation linked annuity

PHASING ALLOCATIONS USED



PHASING ALLOCATIONS APPLIED

Years to retirement	10	9	8	7	6	5	4	3	2	1
Equity	58%	58%	58%	53%	49%	45%	42%	37%	28%	25%
Bond	6%	6%	6%	9%	11%	13%	15%	14%	15%	15%
ILB	4%	4%	4%	5%	6%	6%	6%	7%	8%	8%
Cash	6%	6%	6%	10%	15%	19%	23%	29%	42%	47%
Matching	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Commodoties	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Property	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Listed Property	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Global Equity	15%	15%	15%	14%	12%	11%	9%	8%	5%	3%
Global Bond	6%	6%	6%	6%	5%	5%	4%	4%	2%	1%
Global Cash	4%	4%	4%	4%	3%	3%	2%	2%	1%	1%