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Comparing annuity options under ruin theory and discounted utility

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2012 CONVENTION 16 – 17 OCTOBER

Agenda

1. Megan: Why we wrote this paper
2. Dwayne: What we did
3. Brian: What we found
4. Megan: Why it matters

Why Annuity Choice Matters

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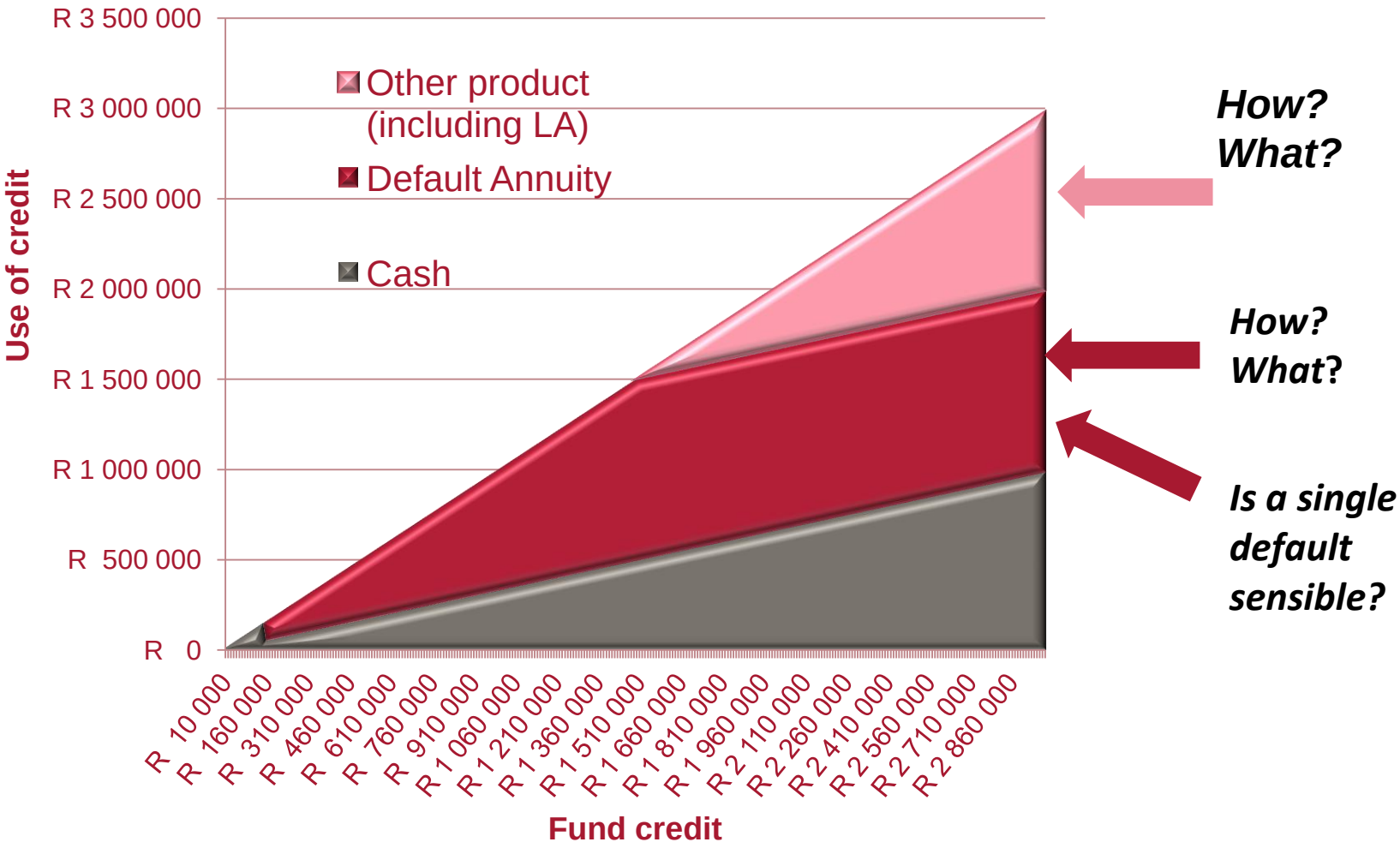
- Proposal: all fund members will need to annuitise 2/3rds
- Currently, life and living annuities qualify as annuities
- How do retirees choose the between living, level, fixed-increase and inflation-linked annuities?
  - Longevity risk
  - Liquidity risk
  - Bequest motive

Reform Proposal 1: May 2012

- "standardised products into which retirement funds can automatically place members when they retire, without requiring financial advice"
- The proposals introduce serious risk for funds and may not reduce the risks that members face

Reform Proposal 2: September 2012



How?

- Evaluated each post-retirement investment strategy using the two most common annuity evaluation methods in the literature:
  - Ruin theory:
    - Ranked by min probability of not achieving a certain income level
  - Discounted utility model (Blake, Cairns & Dowd, 2003) (BCD, 2003)
    - Ranked by utility measure
- Health warnings!
  - Consistency and comparability vs best measures

Model Implementation

- Maitland Stochastic Asset model for SA (Maitland, 2010)
- Actual annuity quotes (best across insurers)
- Mortality
  - Stochastically simulated
  - PA(90) -3 years for males and -2 years for females
  - 1.5% p.a. improvement from 2012

Ruin Theory Implementation

- Pr(income falls below target income)
- Target income tested at two levels (‘necessities’ & ‘comfort’)
- Each year income required is increased for inflation

Discounted Utility Implementation

- BCD (2003) formulation of discounted utility model
- Measures income relative to benchmark strategy
  - Income available level annuity (BCD, 2003)
  - Income available under inflation linked (own)
  - Necessity income level increasing with inflation (own)
- Intertemporal discounting
- Includes terms for:
  - Income
  - Reversionary income
  - Bequests considered explicitly

Technical Basis of DU

$$U^* = \int_0^b U(x) e^{-\beta t} dt$$

Annuitisation strategies

	Annuitisation strategies
1	Level
2	Fixed 5%
3	Inflation-linked
4	0/100 LwA
5	25/75 LwA
6	50/50 LwA
7	75/25 LwA
8	0/100 LA
9	25/75 LA
10	50/50 LA
11	75/25 LA

- a/b – allocations to local equities (a) and fixed-interest (b)
- a/b LwA – living annuity→ inflation-linked annuity at age 75
- a/b LA – living annuity
- Life annuities:
  - 10-year guarantee period
  - 75% spouse's reversion (where applicable)

Demographic scenarios

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Case	Member age	Member gender	Spouse age	Drawdown (necessities)	Drawdown (comfort)
1	65	Male	61	5.2%	6.6%
2	60	Male	56	5.2%	6.6%
3	65	Male	-	5.2%	6.6%
4	65	Female	69	5.2%	6.6%
5	65	Male	61	4.2%	5.6%
6	65	Male	61	6.0%	7.4%

LA and LwA

- R1 million starting capital
- For life annuities, starting income levels were based on actual quotes in market (at first week of July)

Base: Male (65) and Female (61)

	Best	2nd Best	2nd Worst	Worst
Comfort income: R5 500 per month				
Ruin theory	75/25 LA (*48% ruin probab*)	50/50 LA (51%)	Level (83%)	I-L and F5% (100%)
DU: Level	**Level**	25/75 L**w**A	50/50 LA	75/25 LA
DU: I-L	**Fixed 5%**	**I-L**	0/100 LA	75/25 LA
DU: Nec	75/25 L**w**A	50/50 L**w**A	0/100 LA	75/25 LA

	Best	2nd Best	2nd Worst	Worst
Necessities income: R4 300 per month				
Ruin theory	**Fixed 5%** (20%)	50/50 LA (28%)	Level (69%)	I-L (100%)
DU: Level	Level	Fixed 5%	50/50 LA	75/25 LA
DU: I-L	Fixed 5%	25/75 LwA	50/50 LA	75/25 LA
DU: Nec	**25/75** LA	75/25 LwA	Level	75/25 LA

Comments on Base Scenario

- **Best** strategy under
  - Ruin theory – LA 75/25 or Fixed 5% (depending on income requirement) [LA 50/50 2nd best]
  - DU Level – Level annuity
  - DU: I-L – Fixed 5% escalation annuity
- **Worst** strategy under
  - Ruin theory – Inflation-linked annuity [Level annuity 2nd worst]
  - DU: Level, IL or Nec – LA 75/25

Best strategies under different demographic scenarios

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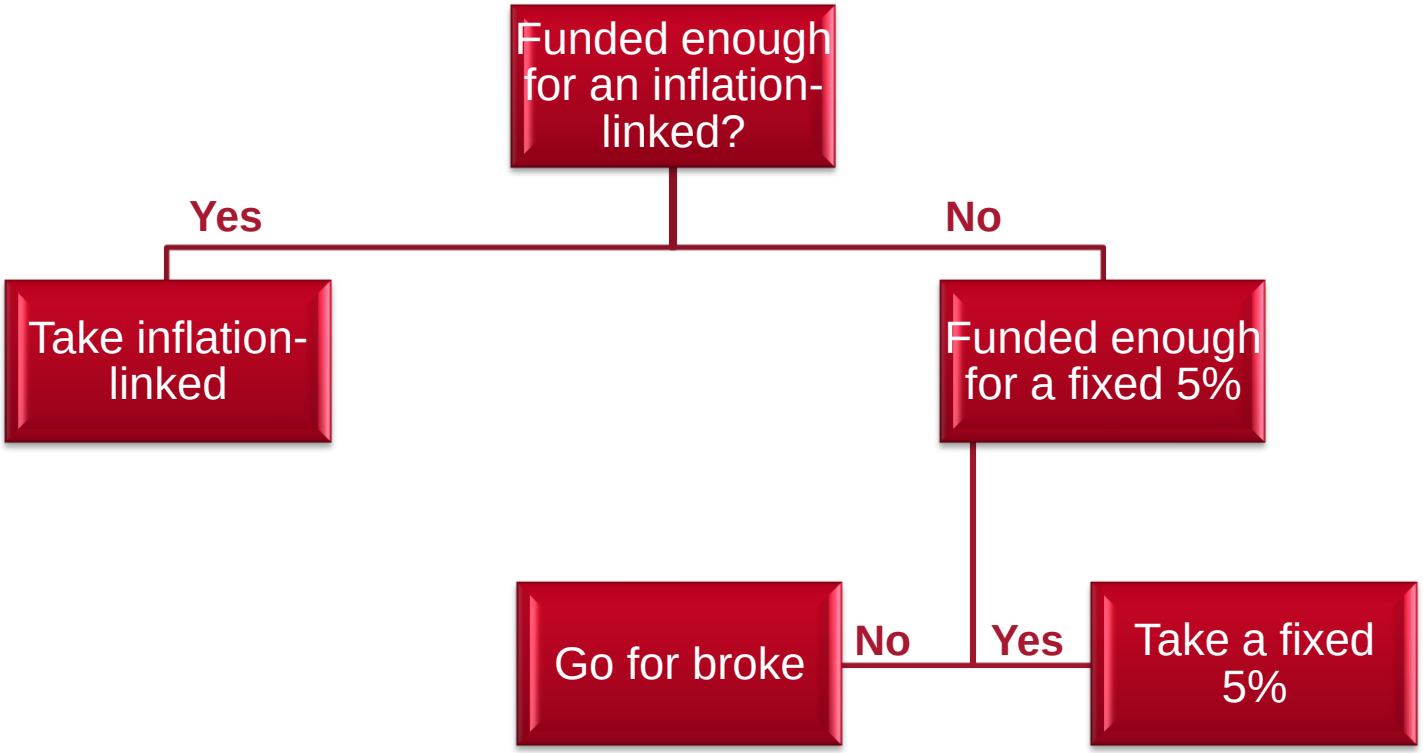
Income for	Comfort		Necessity	
	Ruin theory	DUN	Ruin theory	DUN
Base M65F61	75/25 LA	75/25 LwA	F5%	25/75 LA
M60F56	75/25 LA	50/50 LwA	75/25 LA	50/50 LwA
M65, no spouse	I-L	25/75 LA	I-L	25/75 LA
F65M69	75/25 LA	50/50 LwA	I-L	25/75 LA
Base but better funded (lower income needs)	75/25 LA and 50/50 LA	25/75 LA	I-L	25/75 LA
Base but worse funded (higher income needs)	75/25 LA	75/25 LwA	75/25 LA and 50/50 LA	75/25 LwA

Sensitivity to demographic changes

- Ruin theory – little change from base scenario, unless funding sufficient for an inflation-linked annuity
- DUN – asset allocation in living annuity becomes more/less conservative if size and time period of income needed decreases/increases
- Changes not drastic, suggests results are relatively insensitive to different demographic profiles

Implications – Ruin theory



Implications – Ruin theory

- Probabilities of ruin still significant, even if it appears as the "best" strategy
- Ruin theory favours strategies that have a good chance of beating a defined target, but at the cost of potentially large downside and missing the target by a long shot (generally through living annuities without longevity protection, and exposed to possibly large investment losses)

Implications – Discounted utility

- Compared to ruin theory, good strategies under DU generally:
  - Are more risk- and volatility-averse, as depth of shortfall also considered
  - Provide lifetime income protection
  - “Bird-in-hand” better than “two in the bush” (DU) vs “Go for broke” (RT)
- Type of required income used for anchoring/benchmarking matters (DUL vs DUI vs DUN)

Implications – Discounted utility

- But generally prefer level or fixed-escalation annuities (DUL or DUI), and dislike aggressive living annuities that do not annuitise
- Under DUN criterion, best strategy sensitive to level of "fundedness" (fund credit vs required income) and cost of lifetime income protection
  - Compared to ruin theory, favours annuitisation at some point

Sensitivity of rankings to different parameters under DUL

- DU often considered difficult to parameterise in literature
- We test this perception by varying key parameters
  - Bequest motive
  - Relative risk aversion
  - Force of discount
  - Shape parameter
- Changing the bequest motive parameter had virtually no effect on rankings

Changing Relative Risk Aversion

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RRA	0.3	5.2	10.2	15.1	20.1	25
	Income for comfort					
Level	2	1	1	1	1	1
75/25 LwA	1	8	7	7	7	7
75/25 LA	3	11	11	11	11	11
	Income for necessities					
Level	2	1	1	1	1	1
75/25 LwA	1	9	9	9	8	8
75/25 LA	6	11	11	11	11	11

- Changing RRA generally has no effect on rankings of a strategy, unless the individual is very risk-seeking (with low RRA value)

Changing Force of Discount

Force of discount	0.1%	2.44%	10%
	Income for comfort		
Level	1	1	1
75/25 LwA	7	8	10
75/25 LA	11	11	11
	Income for necessities		
Level	1	1	1
75/25 LwA	9	9	10
75/25 LA	11	11	11

- Surprisingly, changing the real yield of discount drastically also had very little effect on rankings of a strategy

Changing Shape Parameter

d_1	0.05	0.75	0.95	0.05	0.75	0.95
	Income for comfort			Income for necessities		
Level	11	1	1	11	1	1
75/25 LwA	4	8	8	5	9	9
75/25 LA	2	11	11	3	11	11

- Base shape parameter used in BCD (2003) was 0.75. Increasing this value has no effect on rankings
- Decreasing this parameter (hence changing the shape of underlying utility function) can change rankings, favouring the more aggressive strategies

Sensitivity of rankings to parameter changes

- Rankings of strategies generally insensitive to changing parameters, other than for:
  - Very low RRA values (for very risk-seeking individuals)
  - Decreasing the shape parameter (and changing the shape of underlying utility function)

Why it matters?

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- How the default strategy is selected will be critical:
  - Model type
    - Level, Linked and Necessities
- Living annuities may form part of an optimal strategy even for a lower-income earner
- A ‘one-size-fits-all’ approach won’t be flexible enough
- “Fundedness” : DUN and Ruin Theory
  - Detailed needs assessment, in some cases tailored advice

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Thank you