Evaluating Post-Retirement Investment Strategies

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Introduction

• Why did we write the paper?

• A practitioner’s perspective

• Our experience is that of the SA landscape
Introduction

- We consider an individual at point of retirement
  - Accumulated assets
  - No guaranteed retirement income

- Paper considers advice provided to member at time of retirement
Risks

• Retirees face many risks in retirement
  – Inflation risk
  – Longevity risk
  – Consumption risk
  – Annuitisation/interest rate risk
  – Investment risk
Risks

• Investment strategy needs to address these risks

• Complicated by irreversibility of the decision
Investment literature

- So what should an individual do at point of retirement?
- Notable literature exists on the topic
- Yaari (1965) – in absence of bequest motive, shows it is optimal to fully annuitise
Investment literature

- Milevsky et al (1977) – use a ruin probability measure to determine optimal allocation to risky assets.
  - Consumption assumed to be that of life annuity
  - Ruin defined as running out of funds
Investment literature

• Albrecht and Maurer (2002) – use a ruin probability measure to compare life annuity with investment in mutual funds

• Mutual fund drawdown assumed to be equivalent to that of the life annuity
Investment literature

- Power utility function used
Investment literature

• Much of the literature provides recommendations that could be made in absence of knowing anything about reitree

• Exception are those based on utility function approach
Advice Framework

• We believe cognisance of income requirements of individual in retirement is essential

• Ruin has no meaning for a life annuity when defined as running out of funds

• Rather, ruin is experienced when individual is unable to sustain a certain standard of living
Funding Level

• Introduce Funding Level for a DC retiree

• Funding Level typically a DB term

\[
Funding \ Level(t) = \frac{\text{Assets of member at time } t}{\text{Liability of member at time } t}
\]
Funding Level

• We define liability value of individual as cost of guaranteeing
  – Monthly income requirement;
  – In real terms;
  – For rest of lifetime.

• Liability therefore has a market value provided by the cost of an appropriate inflation-linked life annuity
Funding Level

• Example:
  – A male retiree aged 65
  – Accumulated Funds R1,000,000
  – Monthly income requirement R8,000
Funding Level

• Example:
  – Cost of securing inflation-linked life annuity of R8,000 is R1,449,275
  – Individual thus has 69% of funds required
  – Individual has 69% funding level (deficit)
  – R1,000,000 can be used to secure R5,556 from same insurer
Funding Level

• Need to incorporate time and income needs
• Framework flexible
• Useful starting point
  – Funding level function of consumption required
  – Annuitisation risk explained

\[
Funding \ Level \ (C,t) = \frac{Assets \ of \ member \ at \ time \ t}{Liability \ of \ member \ at \ time \ t}
\]
Funding Level

- Many of the retiree risks are incorporated within this measure
  - Monthly income requirement [consumption]
  - In real terms [inflation]
  - For rest of lifetime [longevity]
Funding Level

• Funding Level in excess of 100%
  – Inflation-linked annuity risk-free option
• Funding Level lower than 100%
  – No risk-free solution exists
  – Reconsider monthly income requirement
    OR
  – Some level of risk required to meet consumption needs (inflation, longevity and/or investment)
Funding Level

• Individual income requirements
  – Determine with assistance of financial planner
  – Various levels of income required
    • Living comfortably
    • Providing for necessities
    • Survival income level
Funding Level

• Individual income requirements
  – Majority of individuals won’t be able to support initial income required for comfort
  – Financial planners have evolved into “life planners” (Eisenberg, 2006)
Example ctd

• Individual income required
  – For comfort: R8,000 per month
  – For necessities: R5,500 per month

• Funding level
  – 69% funded on comfort income basis
  – 101% funded on necessity income basis
Funding Level

• Majority of South Africans in deficit on income required for comfort basis
• No risk-free solution exists
• Alternative strategies need to be considered
Evaluating investment strategies

• We compare various investment strategies available to a retiree
  – Nominal level life annuity
  – Nominal escalating life annuity
  – Inflation-linked life annuity
  – Income drawdown facility

• Assessment criterion required
Evaluating investment strategies

• Milevsky defines a ruin probability as follows

\[ \Phi(w) = \Pr \left[ \inf_{0 \leq t \leq T} W_t \leq 0 \mid W_0 = w \right] \]

• Ruin occurs when the lowest value of the wealth process breaches zero before death at T

• Function of initial wealth
Evaluating investment strategies

• We modify the ruin probability formula as follows

\[ \Phi(f, C) = \Pr \left[ \inf_{0 \leq t \leq T} C_t \leq C \mid F_0 = f \right] \quad (1) \]

• Ruin calculates likelihood of individual consuming at a real level lower than that required during lifetime

• Function of income required and initial wealth
Evaluating investment strategies

• Example continued:
  – Pricing obtained for each of the life annuities assuming funds of R1,000,000

<table>
<thead>
<tr>
<th>Type of Life Annuity</th>
<th>Initial level of monthly income</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nominal level life annuity</td>
<td>R10,643</td>
</tr>
<tr>
<td>Nominal escalating life annuity</td>
<td>R8,664</td>
</tr>
<tr>
<td>Inflation-linked life annuity</td>
<td>R5,556</td>
</tr>
</tbody>
</table>

1st July 2009
Evaluating investment strategies

• Example continued:
  – R1,000,000 invested in a mutual fund consisting of two assets
  – Local equities and nominal government bonds
  – Allocation to equities: 0%, 25%, 50% & 75%
Example ctd

• The income drawdown facility permits the member to specify a monthly income draw

• SA legislation stipulates that drawdown p.a. should be between 2.5% and 17.5% of asset value

Which strategy is optimal for individual?
Evaluation of ruin probability

\[ \phi(f, C) = \Pr[\inf_{0 \leq t \leq T} C_t \leq C | F_0 = f] \]  \hspace{1cm} (1)

- Discrete time framework used
- Simulation techniques
Evaluation of ruin probability

• Numerically, calculated as follows:

\[ \phi(f, c) = \frac{1}{N} \sum_{i=1}^{N} \sum_{t=1}^{K} F_{i,t} S_{i,t} \]

• \( F_{i,t} \) is the financial ruin indicator
  - 0 if \( C_{i,t} \geq C \)
  - 1 otherwise

• \( S_{i,t} \) is the mortality indicator
  - 1 if member has died in year \( t \) or prior to year \( t \)
  - 0 otherwise
Assumptions

• Simulations done in MATLAB
• Income received at the end of each year
• Maitland Model used
• Mortality assumed to be PA(90)-3 (1.5% p.a. mortality improvement)
### Ruin Probability Results

<table>
<thead>
<tr>
<th>Income Required</th>
<th>Level Annuity</th>
<th>Escalating Annuity</th>
<th>Inflation-linked Annuity</th>
</tr>
</thead>
<tbody>
<tr>
<td>500</td>
<td>0.00%</td>
<td>0.00%</td>
<td>0.00%</td>
</tr>
<tr>
<td>1,000</td>
<td>0.80%</td>
<td>0.00%</td>
<td>0.00%</td>
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<tr>
<td>1,500</td>
<td>6.90%</td>
<td>0.00%</td>
<td>0.00%</td>
</tr>
<tr>
<td>2,000</td>
<td>16.70%</td>
<td>0.00%</td>
<td>0.00%</td>
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<tr>
<td>2,500</td>
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<td>0.80%</td>
<td>0.00%</td>
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<tr>
<td>3,000</td>
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<td>0.00%</td>
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<td>3,500</td>
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<td>10.80%</td>
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<td>4,000</td>
<td>52.60%</td>
<td>21.20%</td>
<td>0.00%</td>
</tr>
<tr>
<td>4,500</td>
<td>59.80%</td>
<td>31.40%</td>
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<tr>
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<td>66.10%</td>
<td>42.60%</td>
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<td>76.00%</td>
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<td>97.20%</td>
</tr>
<tr>
<td>6,500</td>
<td>79.70%</td>
<td>73.70%</td>
<td>97.20%</td>
</tr>
<tr>
<td>7,000</td>
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<td>97.20%</td>
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<td>97.20%</td>
<td>97.20%</td>
</tr>
<tr>
<td>10,000</td>
<td>95.40%</td>
<td>97.20%</td>
<td>97.20%</td>
</tr>
</tbody>
</table>
Results

• Under this ruin measure, life annuities can have a non-zero probability of ruin
• Ruin is 0% or 100% in the case of an inflation-linked annuity
• Level, escalating and inflation-linked annuities have different levels where ruin is minimised
• Consumption level of member is key
## Ruin Probability Results

<table>
<thead>
<tr>
<th>Income Required</th>
<th>0% Equity</th>
<th>25% Equity</th>
<th>50% Equity</th>
<th>75% Equity</th>
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<tbody>
<tr>
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<td>0.00%</td>
</tr>
<tr>
<td>1,000</td>
<td>0.00%</td>
<td>0.00%</td>
<td>0.00%</td>
<td>0.40%</td>
</tr>
<tr>
<td>1,500</td>
<td>0.00%</td>
<td>0.00%</td>
<td>0.20%</td>
<td>0.50%</td>
</tr>
<tr>
<td>2,000</td>
<td>0.00%</td>
<td>0.00%</td>
<td>0.40%</td>
<td>1.50%</td>
</tr>
<tr>
<td>2,500</td>
<td>0.00%</td>
<td>0.30%</td>
<td>1.10%</td>
<td>3.30%</td>
</tr>
<tr>
<td>3,000</td>
<td>0.50%</td>
<td>1.20%</td>
<td>2.70%</td>
<td>6.20%</td>
</tr>
<tr>
<td>3,500</td>
<td>5.10%</td>
<td>2.80%</td>
<td>5.70%</td>
<td>12.90%</td>
</tr>
<tr>
<td>4,000</td>
<td>17.60%</td>
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<td>19.90%</td>
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<tr>
<td>4,500</td>
<td>32.10%</td>
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<td>21.60%</td>
<td>26.50%</td>
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<tr>
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<td>33.90%</td>
<td>33.00%</td>
<td>33.70%</td>
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<tr>
<td>5,500</td>
<td>58.20%</td>
<td>46.00%</td>
<td>40.60%</td>
<td>41.30%</td>
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<tr>
<td>6,000</td>
<td>66.20%</td>
<td>57.70%</td>
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<tr>
<td>6,500</td>
<td>72.20%</td>
<td>65.80%</td>
<td>57.30%</td>
<td>54.10%</td>
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<tr>
<td>7,000</td>
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<tr>
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<td>89.10%</td>
<td>88.90%</td>
<td>86.70%</td>
<td>82.40%</td>
</tr>
</tbody>
</table>
Example ctd

- No one size fits all solution.
- Income preference is key

<table>
<thead>
<tr>
<th>Investment Strategy</th>
<th>Income requirement of R5,500</th>
<th>Income requirement of R8,000</th>
</tr>
</thead>
<tbody>
<tr>
<td>Level Annuity</td>
<td>71.70%</td>
<td>88.30%</td>
</tr>
<tr>
<td>3% p.a. Escalating Annuity</td>
<td>53.50%</td>
<td>91.40%</td>
</tr>
<tr>
<td>Inflation-linked annuity</td>
<td>0.00%</td>
<td>97.20%</td>
</tr>
<tr>
<td>Income drawdown (best case)</td>
<td>40.6%</td>
<td>70.3%</td>
</tr>
</tbody>
</table>
Results

• Level annuity income 33% higher than the income for comfort level.
• $\text{Pr(ruin)}$ is 88%
• Minimised at 70% for an income drawdown strategy
• Other strategies exist which minimise further
Implications for advice

• Ruin probability can be used as part of a consulting framework
• Not just an academic measure
• Risk of misselling minimised
Funding level and Ruin Probability Framework

• Flexible
• Any strategy can be incorporated
• Illustrates that there is no unique solution for retirees and that customisation needed for post-retirement advice
Conclusions

• Ruin probability measure improvement over others as actual income requirements of members taken into account

• Takes cognisance of annuitisation, consumption, inflation and longevity risk
Conclusions

• Funding Level measure can be used for ongoing advice
• Useful for definition of a minimum risk investment
• Framework allows individuals to appreciate the impact of changing their consumption behaviour
Scope for future research

• Strategies for those individuals in deficit and how it varies based on extent of deficit
• Integration of pre and post retirement investment strategies
• Concept of deferring annuitisation with the aim of obtaining 100% funding level
Scope for future research

• Extent of ruin measure can be developed
• Propensity to take risk and utility associated with different income levels not taken into account. Utility function elicitation can be explored further
Thank you