Managing Investment Risk in Life Risk Products

Karun Varughese and Pieter Wessels
Agenda

1. Introduction

2. Sketch of an average life risk product

3. Matching and asset supply

4. Practical examples
   • Input
   • Investigations
   • Results and conclusions
   • Other considerations

5. Questions
Introduction

• Investment risk is pertinent in life insurance products, even though:
  • Cashflows are known
  • Bonds used to match cashflows
  • Bonds have known cashflows
  • Asset/Liability matching seems easily possible
• The main issue: Mismatch risk
  • Initial liability cashflows are positive (negative reserves)
  • Liabilities have a long tail (70 years +)
  • Bonds only give positive cashflows
  • Coupons received when not needed (positive liability cashflows)
  • Bonds only available up to 35 years
• This causes an investment mismatch risk
Cashflows of an initial positive reserve life risk book

Graph1a: A book with an initial net positive reserve

- **Premium**
- **Expenses**
- **Death benefit**
- **Net Cashflow**

Time

ZAR
Reserves of an initial positive reserve life risk book

Graph1b: A book with an initial net positive reserve

Unzeroised Reserve
Cashflows of an initial negative reserve life risk book

Graph2a: A book with an initial net negative reserve

- Premium
- Expenses
- Death benefit
- Net Cashflow

Time

ZAR
Reserves of an initial negative reserve life risk book

Graph2b: A book with an initial net negative reserve

<table>
<thead>
<tr>
<th>ZAR</th>
<th>Time</th>
</tr>
</thead>
</table>

Unzeroised Reserve
Asset supply

- Government fixed interest bonds:
  - Largest issues by Treasury
  - Maturities range from 1 to 35 years
  - Most suited to backing liabilities since large issues and fairly liquid
- Other securities:
  - Zero-coupon government bonds – relatively small issues
  - Foreign bonds – currency risk
  - Corporate bonds – short term/credit risk
  - Derivatives – good for matching liabilities, but added complexities and regulatory requirements:
    - Swaps
    - Forwards/futures
Matching liabilities

• Within life insurance liability portfolio matching
  • Negative and positive cashflows from different policies net off against each other

• Annuity and life risk product matching
  • Annuity and life risk book have opposite cashflow profile.
  • Could net off cashflows
  • UPF vs IPF introduces tax complexities (timing mismatch)

• We assume within product matching but not across products for this investigation

• Mismatch:
  • Not wide enough range of assets to perfectly match
  • Reinvestment risk:
    • Future coupons need to be invested
    • Bonds need to be reinvested after they mature
Practical examples

Input

• We investigated two subsets of death cover only products:

1. Optional growth
   • Premium and cover growth are optional.
     – Policyholders can choose to skip growth annually.

• Following growth structures are available:

<table>
<thead>
<tr>
<th>Option</th>
<th>Premium growth</th>
<th>Cover growth</th>
</tr>
</thead>
<tbody>
<tr>
<td>Option1</td>
<td>5%</td>
<td>3.5%</td>
</tr>
<tr>
<td>Option2</td>
<td>10%</td>
<td>7%</td>
</tr>
<tr>
<td>Option3</td>
<td>Inflation +3%</td>
<td>Inflation</td>
</tr>
</tbody>
</table>

• Have a guaranteed term of 5 to 25 years.
  – Insurer can impose management actions after this.
  – We investigate a 5% increase in premium growth rate
2. Non-optional growth

- These policies had the following growth structure:

<table>
<thead>
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<th>Option1</th>
<th>Premium growth</th>
<th>Cover growth</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>11%</td>
<td>3.5%</td>
</tr>
</tbody>
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- Premium and cover growth is guaranteed for life
- No reviewing of premium/cover is available to insurer
- For our example the resulting cashflow pattern caused negative reserves early on
Practical examples

Input – assets

- Bonds
  - We consider only fixed interest government bonds
  - Use the 20 largest issues
  - Maturity terms are range from 1 to 35 years
  - R2048 is the longest duration bond

- Cashflow profiles
  - Unzeroised best estimate liability cashflows are used to develop an investment strategy

- Yield curves
  - Best estimate return is a smoothed version of the government bond yield curve
  - Use an ESG with Best Estimate curve as base to generate 2000 simulated yield curves
  - Each simulation is an instantaneous shock to the yield curve
Practical examples
Building an investment strategy

- Need a strategy to minimise mismatch risk
  - We consider delta hedging and cashflow matching
  - Consider strategies with both shorting and no shorting of bonds

- Delta hedging
  - Stress yield curve at bond maturity points such that the bond yield to maturity increases by 1 bps
  - Start at longest duration bond maturity and work backwards i.e.
    - Invest in sufficient bonds so that a 1bip change to yield to maturity causes same change to asset and liability value
    - Start process with longest duration bond, and iteratively work backwards to shortest duration bond
    - Cash held as balancing item to make assets=liabilities

- Cashflow matching
  - Choose shortest duration bonds which can be sold off to meet the liability cashflow at each time
  - Start at time 0 and work forward
  - No cash holdings required
Practical examples
Calculating the mismatch loss

• Simulations
  • An investment strategy is developed at time 0
  • We keep this strategy fixed over time and simulations
  • We assume a zero return on cash holdings
  • New value of asset portfolio and liability cashflows calculated under each simulation
  • Each simulation is an *instantaneous stress* of the yield curve
  • The delta between bond value and liability value is the mismatch loss under each simulation
  • Choose the 95th percentile as the loss we would like to avoid
    • Hold extra R2048 bonds to the value of loss
    • Recalculate mismatch loss with this new strategy
We performed six investigations analysing various aspects of investment risk.

<table>
<thead>
<tr>
<th>Investigation 1</th>
<th>Delta hedging without shorting of bonds</th>
</tr>
</thead>
<tbody>
<tr>
<td>Investigation 2</td>
<td>Delta hedging with shorting of bonds</td>
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<tr>
<td>Investigation 6</td>
<td>Impact of a longer duration government bond being available for matching liabilities</td>
</tr>
</tbody>
</table>
Practical examples
Investigations

Investigation 1  Delta hedging without shorting of bonds

- Develop investment strategy using delta hedging approach
- Constrain bond holdings to be positive
- Calculate 95 percentile mismatch loss
- Invest in extra bonds to meet this loss:
  - Could be considered a discretionary margin
- Recalculate mismatch loss under new strategy
Practical examples
Results and conclusions
Investigation 1

Net Cash Flow

-25
-20
-15
-10
-5
0
5
10
15
20
12/2013
02/2048
ZAR
Millions
Time
Net Cash Flow
Net Cash Flow Non-Optional Growth
Net Cash Flow Optional Growth

-25
-20
-15
-10
-5

Net Cash Flow Non-Optional Growth
Net Cash Flow Optional Growth
Practical examples
Results and conclusions Investigation 1
Practical examples

Results and conclusions Investigation 1

Base ESG yield

- Base Forward ESG yield (NACA)

Percentage vs. Time

12/2013 to 02/2048
**Investigation 1: Delta hedging without shorting**

**Optional growth structure vs Non-optional growth structures**

- For a delta hedged position we require the following composition of bonds (long).

<table>
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<tr>
<th>@31 December 2013 (ZAR)</th>
<th>Unzeroised reserve</th>
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</tr>
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<tbody>
<tr>
<td>Investigation 1</td>
<td></td>
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<td></td>
</tr>
<tr>
<td>Delta hedging without shorting: <strong>Optional Growth Structure</strong></td>
<td>149m</td>
<td>2 377m</td>
<td>-2 229m</td>
</tr>
<tr>
<td>Investigation 1</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Delta hedging without shorting: <strong>Non-optional Growth Structure</strong></td>
<td>-381m</td>
<td>78m</td>
<td>-459m</td>
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</tbody>
</table>
Investigation 1 Optional Growth

Total bond value ZAR millions

<table>
<thead>
<tr>
<th>RSA Government Bonds</th>
<th>Total bond value</th>
<th>Delta hedging without shorting: Optional Growth Structure Split per bond</th>
</tr>
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<tbody>
<tr>
<td>R 2,048</td>
<td>1765</td>
<td>Delta hedging without shorting: Optional Growth Structure</td>
</tr>
<tr>
<td>R 214</td>
<td>413</td>
<td>Split per bond</td>
</tr>
<tr>
<td>R 2,037</td>
<td>185</td>
<td>Delta hedging without shorting: Optional Growth Structure</td>
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<tr>
<td>R 202</td>
<td>14</td>
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</tr>
<tr>
<td>Total</td>
<td>2,377</td>
<td>Total Bonds</td>
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Investigation 1 Non-optional Growth

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<td>73</td>
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<tr>
<td>R 214</td>
<td>5</td>
</tr>
<tr>
<td>Total</td>
<td>78</td>
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- Delta hedging without shorting: Non-optional Growth Structure Split per bond
- Delta hedging without shorting: Non-optional Growth Structure Total Bonds
Practical examples

Results and conclusions

Investigation 1: Delta hedging without shorting

Optional growth structure vs Non-optional growth structures

Simulations

- From 2000 ESG real world model scenarios we obtain the following:

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Practical examples
Results and conclusions Investigation 1
Optional growth structure

Dispersion of mismatch losses (positive values = loss)

- Number of scenarios
- Size of mismatch loss (millions)

- Base delta hedged strategy/Before holding additional R2048 bonds
- After holding only additional R2048 bonds
## Practical examples

### Results and conclusions Investigation 1

**Non-optional growth structure**

### Dispersion of mismatch losses (positive values = loss)

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<th>Number of scenarios</th>
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<td>(250;300)</td>
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<td>(250;200)</td>
<td>0</td>
</tr>
<tr>
<td>(200;150)</td>
<td>0</td>
</tr>
<tr>
<td>(150;100)</td>
<td>0</td>
</tr>
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<td>(100;50)</td>
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- **Base delta hedged strategy/Before holding additional R2048 bonds**
- **After holding only additional R2048 bonds**
Practical examples
Investigations

We performed six investigations analysing various aspects of investment risk.

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Practical examples
Investigations

Investigation 2
Delta hedging with shorting of bonds

- Repeat investigation 1
- Bond holdings not constrained to being positive.
- Calculate mismatch loss where there is shorting of bonds
- Compare this to investigation 1 to find the effect of shorting bonds on improving matching
Investigation 2: Delta hedging with shorting

Investigation 1 vs 2 (delta hedging with and without shorting)

Non-optional growth structure

- For a delta hedged position we require the following composition of bonds (long and short).

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Practical examples
Results and conclusions Investigation 2

Investigation 1 vs 2 Non-optional Growth

Total bond value ZAR millions

Delta hedging without shorting: Non-optional Growth Structure
- Split per bond
- Total bonds

Delta hedging with shorting: Non-optional Growth Structure
- Split per bond
- Total bonds

RSA Government Bonds

Investigation 1
Investigation 2

Total Without Shorting
Total With Shorting
Investigation 2: Delta hedging with shorting

**Investigation 1 vs 2 (delta hedging with and without shorting)**

**Non-optional growth structure**

**Simulations**
- From 2000 ESG real world model scenarios we obtain the following:

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<th>Investigation 2 Delta hedging with shorting: Non-optional Growth Structure</th>
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<td>6m</td>
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Practical examples

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Practical examples

Investigations

Investigation 3  Impact of management actions

- Concerns only policies with optional growth
- To what extent does management actions in the face of adverse investment conditions reduce the mismatch risk?
- We consider the investment strategy from Investigation 1 and identify the 95th percentile scenario
- In this scenario we calculated the effect of increasing the premium growth rate by 5% while maintaining the current cover growth rate
- The reduction in the loss in this scenario is compared to what would happen without management actions
Practical examples

Results and conclusions Investigation 3

Net Cash Flow Optional Growth

- Net Cash Flow with management actions
- Net Cash Flow without management actions

Time

12/2013 02/2048

Millions

ZAR

-20 -15 -10 -5 0 5 10 15 20

-25 -20 -15 -10 -5 0 5 10 15 20

10/2013 02/2048

12/2013 02/2048

ZAR

-20 -15 -10 -5 0 5 10 15 20

-25 -20 -15 -10 -5 0 5 10 15 20

10/2013 02/2048

ZAR

-20 -15 -10 -5 0 5 10 15 20

-25 -20 -15 -10 -5 0 5 10 15 20

10/2013 02/2048

ZAR

-20 -15 -10 -5 0 5 10 15 20

-25 -20 -15 -10 -5 0 5 10 15 20

10/2013 02/2048

ZAR

-20 -15 -10 -5 0 5 10 15 20

-25 -20 -15 -10 -5 0 5 10 15 20

10/2013 02/2048

ZAR

-20 -15 -10 -5 0 5 10 15 20

-25 -20 -15 -10 -5 0 5 10 15 20

10/2013 02/2048

ZAR
Practical examples
Results and conclusions Investigation 3

Reserve Optional Growth

- Reserve with management actions
- Reserve without management actions
### Investigation 3: Delta hedging vs management actions

#### Optional growth structure

**Simulations**
- From 2000 ESG real world model scenarios we obtain the following:

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</tr>
<tr>
<td>Reduction in 95th percentile mismatch loss</td>
<td></td>
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</tr>
<tr>
<td>Due to management actions</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Practical examples
Results and conclusions Investigation 3
Optional growth structure

Dispersion of mismatch losses (positive values = loss)

- Base delta hedged strategy/Before imposing management actions or holding additional R2048 bonds
- After imposing only management actions
- After holding only additional R2048 bonds

Number of scenarios
Size of mismatch loss (millions)
Practical examples
Investigations

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</tbody>
</table>
Practical examples

Investigations

Investigation 4  Cashflow matching

- Develop investment strategy using cashflow matching approach
- We allow shorting of bonds
- Calculate 95 percentile mismatch loss
- We compare this to the mismatch loss in investigation 2 to compare the efficiency of the delta hedged strategy and the cashflow matching strategy
Investigation 4: Cashflow matching

Investigation 2 vs 4 (delta hedging with shorting and cashflow matching)

- For a delta hedged position we require the following composition of bonds (long and short).

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<tr>
<th>@31 December 2013 (ZAR)</th>
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<td></td>
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</tr>
<tr>
<td>Investigation 4</td>
<td>-381m</td>
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<td>0m</td>
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<tr>
<td>Cashflow matching with shorting: Non-optional Growth Structure</td>
<td></td>
<td></td>
<td></td>
</tr>
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Practical examples
Results and conclusions Investigation 4

Investigation 2 vs 4 Non-optional Growth

Total bond value ZAR millions

-500 -400 -300 -200 -100 0 100 200

R 2 048
R 2 037
R 202
R 2 030
R 210
R 197
R 212
R 207
R 203
R 158
R 201
R 2 048
R 209
R 202
R 2 030
R 186
R 2 023
R 208
R 204
R 159
R 157

Total with shorting: Cashflow matching Investigation 4

Delta hedging with shorting: Non-optional Growth Structure Split per bond
Delta hedging with shorting: Non-optional Growth Structure Total bonds
Cashflow matching with shorting: Non-optional Growth Structure Split per bond
Cashflow matching with shorting: Non-optional Growth Structure Total bonds
### Investigation 4: Cashflow matching

**Investigation 2 vs 4 (delta hedging with shorting and cashflow matching)**

**Simulations**

- From 2000 ESG real world model scenarios we obtain the following:

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<td>95th percentile mismatch loss</td>
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<td>18m</td>
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Investigation 5: Impact of FSV margins

- Investigate the effect of SAP104 interest rate margins on reducing mismatch risk
- Liability cashflows projected with 1\textsuperscript{st} tier margins
- Developed new investment strategy using base best estimate yield curve
- We calculated 95\textsuperscript{th} percentile mismatch loss and identify scenario which causes it
  - We develop a new investment strategy based on yield curve with 1\textsuperscript{st} tier margins – find effect of new strategy on the mismatch loss in the 95 percentile scenario
- We also check how large the effect of the OCAR investment margin is on mismatch losses
- Use these to analyse whether:
  - interest rate margins are sufficiently large
Practical examples
Results and conclusions Investigation 5

Net FSV Cash Flow

-25
-20
-15
-10
-5
0
5
10
15
20

12/2013
02/2048

ZAR
Millions

Time

-25
-20
-15
-10
-5
0
5
10
15
20

Net FSV Cash Flow Optional Growth
Practical examples
Results and conclusions Investigation 5

FSV Reserve

- Optional Growth Reserve using base ESG yield curve
- Optional Growth Reserve using base ESG yield curve -25bps 1st tier margin
- Optional Growth Reserve using base ESG yield curve -25bps 1st tier margin + additional 2nd tier margin
Practical examples
Results and conclusions Investigation 5

Yield curves Optional Growth

- Base ESG yield curve
- Base ESG yield curve -25bps 1st tier margin
- Base ESG yield curve -25bps 1st tier margin + additional 2nd tier margin

Percentage vs. Time

12/2013 to 02/2048

2014 Convention knowing more 22-23 October, Cape Town
Practical examples

Results and conclusions Investigation 5

Total bond value ZAR millions

- Delta hedging without shorting: Optional Growth Structure
- Delta hedging without shorting: Optional Growth Structure - DM
- Delta hedging without shorting: Optional Growth Structure (using FSV cashflows and BE yield)

Investigation 5 (FSV CF, BE yield)
Investigation 5 (FSV CF, BE yield -25bps CM)
Investigation 5 (FSV CF, BE yield -25bps CM - DM)
Practical examples
Results and conclusions Investigation 5

Investigation 5: FSV Compulsory (1st tier) and Discretionary (2nd tier) margins

Optional growth structure

- The table below shows the delta hedged strategies for the respective product books under the base yield excluding and including compulsory and discretionary margins.

<table>
<thead>
<tr>
<th>@31 December 2013 (ZAR)</th>
<th>Unzeroised reserve</th>
<th>Bonds</th>
<th>Cash</th>
</tr>
</thead>
<tbody>
<tr>
<td>Investigation 5</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Delta hedging without shorting: Optional Growth Structure</td>
<td>422m</td>
<td>2 632m</td>
<td>-2 210m</td>
</tr>
<tr>
<td>FSV cashflows with base yield</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Investigation 5</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Delta hedging without shorting: Optional Growth Structure</td>
<td>466m</td>
<td>2 713m</td>
<td>-2 248m</td>
</tr>
<tr>
<td>FSV cashflows with base yield and 25 bps 1st tier margin</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Investigation 5</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Delta hedging without shorting: Optional Growth Structure</td>
<td>498m</td>
<td>3 006m</td>
<td>-2 508m</td>
</tr>
<tr>
<td>FSV cashflows with base yield and 25 bps 1st tier margin and 2nd tier margin</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Investigation 5: FSV Compulsory (1st tier) and Discretionary (2nd tier) margins

Optional growth structure

Simulations

- From 2000 ESG real world model scenarios we obtain the following:

<table>
<thead>
<tr>
<th>@31 December 2013 (ZAR)</th>
<th>Investigation 5 Delta hedging without shorting: Optional Growth Structure (using FSV cashflows)</th>
</tr>
</thead>
<tbody>
<tr>
<td>95th percentile mismatch loss</td>
<td>371m</td>
</tr>
<tr>
<td>Mismatch loss under the same scenario using base yield curve adding 25bps 1st tier margin</td>
<td>397m</td>
</tr>
<tr>
<td>Mismatch loss under the same scenario using base yield curve adding 25bps 1st tier margin and an additional 2nd tier margin (flat yield of 6% after R2048 maturity)</td>
<td>389m</td>
</tr>
<tr>
<td>Mismatch loss under the same scenario using base yield curve adding 25% OCAR stress</td>
<td>152m</td>
</tr>
<tr>
<td>Mismatch loss under the same scenario using base yield curve deducting 25% OCAR stress</td>
<td>-148m</td>
</tr>
</tbody>
</table>
Practical examples
Investigations

We performed six investigations analysing various aspects of investment risk.

<table>
<thead>
<tr>
<th>Investigation 1</th>
<th>Delta hedging without shorting of bonds</th>
</tr>
</thead>
<tbody>
<tr>
<td>Investigation 2</td>
<td>Delta hedging with shorting of bonds</td>
</tr>
<tr>
<td>Investigation 3</td>
<td>Impact of management actions</td>
</tr>
<tr>
<td>Investigation 4</td>
<td>Cashflow matching</td>
</tr>
<tr>
<td>Investigation 5</td>
<td>Impact of FSV margins</td>
</tr>
<tr>
<td>Investigation 6</td>
<td>Impact of a longer duration government bond being available for matching liabilities</td>
</tr>
</tbody>
</table>
Practical examples

Investigations

Investigation 6

Impact of a longer duration government bond being available for matching liabilities

• We assume that the government introduces a new longer dated bond
• Consider two scenarios:
  • The introduction of an R2060 coupon paying bond
  • The introduction of an R2060 zero coupon bond
• Repeat investigation 1 assuming existence of these bonds.
• We compare the results with investigation 1:
  • If the new bond improves risk management sufficiently we can lobby for government to introduce new bonds
Investigation 6: Addition of a longer duration government bond

Investigation 1 vs 6

- For a delta hedged position we require the following composition of bonds (long).

<table>
<thead>
<tr>
<th></th>
<th>Unzeroised reserve</th>
<th>Bonds</th>
<th>Cash</th>
</tr>
</thead>
<tbody>
<tr>
<td>@31 December 2013 (ZAR)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Investigation 1</td>
<td>149m</td>
<td>2 377m</td>
<td>-2 229m</td>
</tr>
<tr>
<td>Delta hedging without shorting: Optional Growth Structure</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Investigation 6</td>
<td>149m</td>
<td>2 233m</td>
<td>-2 085m</td>
</tr>
<tr>
<td>Delta hedging without shorting: Optional Growth Structure Based on R2060 with same coupon rate as R2048</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Investigation 6</td>
<td>149m</td>
<td>2 039m</td>
<td>-1 890m</td>
</tr>
<tr>
<td>Delta hedging without shorting: Optional Growth Structure Based on R2060 with zero coupon rate</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
### Practical examples

#### Results and conclusions

**Investigation 6**

**Investigation 1 vs 6 Optional Growth**

<table>
<thead>
<tr>
<th>Bond Value (ZAR millions)</th>
<th>Total Investigation 1</th>
<th>R2060 same coupon rate as R2048 (coupon rate: 8.75% per year)</th>
<th>R2060 zero coupon rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>R 2 048</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>R 214</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>R 2 037</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>R 209</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>R 202</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Total Investigation 1**

R2060 same coupon rate as R2048/coupon rate: 8.75% per year

<table>
<thead>
<tr>
<th>Bond Value (ZAR millions)</th>
<th>Total Investigation 6 (R2060 with same coupon rate as R2048)</th>
</tr>
</thead>
<tbody>
<tr>
<td>R 214</td>
<td></td>
</tr>
<tr>
<td>R 2 037</td>
<td></td>
</tr>
<tr>
<td>R 209</td>
<td></td>
</tr>
<tr>
<td>R 202</td>
<td></td>
</tr>
</tbody>
</table>

**Total Investigation 6 (R2060 with same coupon rate as R2048)**

R2060 zero coupon rate

<table>
<thead>
<tr>
<th>Bond Value (ZAR millions)</th>
<th>Total Investigation 6 (R2060 with zero coupon rate)</th>
</tr>
</thead>
<tbody>
<tr>
<td>R 214</td>
<td></td>
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<tr>
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<td>R 209</td>
<td></td>
</tr>
<tr>
<td>R 202</td>
<td></td>
</tr>
</tbody>
</table>

**Total Investigation 6 (R2060 with zero coupon rate)**
Investigation 6: Addition of a longer duration government bond

Investigation 1 vs 6

Simulations
- From 2000 ESG real world model scenarios we obtain the following:

<table>
<thead>
<tr>
<th>@31 December 2013 (ZAR)</th>
<th>Investigation 1 Delta hedging without shorting: Optional Growth Structure</th>
<th>Investigation 6 Delta hedging without shorting: Optional Growth Structure Based on R2060 with same coupon rate as R2048</th>
<th>Investigation 6 Delta hedging without shorting: Optional Growth Structure Based on R2060 with zero coupon rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>95th percentile mismatch loss</td>
<td>367m</td>
<td>343m</td>
<td>357m</td>
</tr>
<tr>
<td>Total value of additional bonds required</td>
<td>367m</td>
<td>343m</td>
<td>357m</td>
</tr>
<tr>
<td>Reduction in 95th percentile mismatch loss Due to additional longest duration bonds being added</td>
<td>289m</td>
<td>286m</td>
<td>282m</td>
</tr>
</tbody>
</table>
Practical examples

Results and conclusions Investigation 6

Optional growth structure: Investigation 1 vs 6

Dispersion of mismatch losses (positive values = loss)

- Delta hedged strategy without R2060 available (longest bond available is R2048)
- Delta hedged strategy based on R2060 with same coupon rate as R2048
- Delta hedged strategy based on R2060 with zero coupon rate
Practical examples
Other considerations

- Main aim of our paper: **shed light on extent of investment and re-investment risk**
- We investigated increasing assets and liabilities with a **discretionary margin** to **reduce possible mismatch losses**
- Discretionary margins are invested similar to free surplus
- In absence of increasing discretionary margins, fungibility of capital when mismatch losses crystallise should be investigated
- Our other investigations showed that investment risk can also be managed with:
  - **management actions,**
  - **discretionary yield curve margins and**
  - **shorting strategies.**
- **Securitisation**
  - Shorting can help reduce investment mismatch losses
  - An alternative to shorting could be securities paying coupons from future profits could be used
  - These would be relatively short term securities for the period over which positive cashflows emerge from the book.
  - **The capitalisation of short term positive cashflows would provide additional cash to be invested in longer duration bonds, therefore improving our matching position.**
  - As an alternative to securitisation financial reinsurance can be considered if available.
Practical examples
Other considerations

- **Sovereign risk**
  - From recent recessions we’ve seen that capital and liquidity buffers are used to manage and protect the financial soundness of markets,
  - however fiscal buffers are used to protect the risk free status of government bonds.
  - When following a strategy of increasing government bonds held to reduce investment mismatch losses
  - we will **increase our exposure to sovereign risk**.
  - The **current market consensus in South Africa is still to treat these as risk free assets**.
  - However this might need to be revisited from time to time.

- **SAM**
  - **Under SAM zeroisation will not be an option anymore**.
  - Subsequently we will see increases in solvency capital requirement (SCR), predominantly from increases in lapse risk stresses.
  - **The SCR will be calculated based on the SAM balance sheet which uses best estimate liabilities and a risk margin**.
  - Under an IFRS balance sheet we hold liabilities with prudential FSV margins.
  - Based on our investigations we saw that an **increase in our reserves above our FSV levels with a discretionary margin would reduce our investment mismatch loss risk**.
  - Whether or not we can also increase our liabilities under a SAM balance sheet is debatable.
  - However, we have not investigated this.
Questions