Longevity Risk
Key Trends, Issues and Opportunities

George Graziani FSA FCIA | Senior Vice President | Head Longevity North America
Swiss Re | George_Graziani@SwissRe.com
Key Messages

Longevity Risk is Real

• There is a well defined global upward trend in life expectancy and mortality improvement.

Longevity Risk has Material Financial Impact

• A one year change in life expectancy (a 1% change in mortality improvement) translates into a 4% change in plan liabilities.

There are Practical Solutions for Managing Longevity Risk

• There are practical tools to manage the risk of retirees outliving their finances.
Longevity Capacity Market Size

#1
Demand – Small
Supply - Large

#2
Demand – Medium
Supply - Medium

#3
Demand – Large
Supply - Small
Longevity Capacity
Supply vs Demand

#3

Demand – Large
Supply - Small

Demand for Capacity is Large

DB Pension Plans
Global > USD 23 Trillion
USA > USD 6 T  Canada > USD 1 T

Annuities
USA -Variable Annuity – Total Net Assets
$1.6 Trillion

Supply Capacity is Limited

e.g. Global Insurance Industry Assets
to cover non life risks including Nat Cat is $ 2.3 Trillion
Dave

Age: 70
Gender: Male
Life Expectancy: 16.5 yrs
Smoking Status: Non Smoker
Diet: Healthy
Cholesterol: Low

Dave Loves Longevity
USA Life expectancy continues to improve

US Male Mortality Improvement

- For example, sixty year-olds in 2001 showed an improvement of 2-3%
- This means that, if at the start of 2001, 100 sixty year-olds were expected to die over the year, at the end of 2001, only 97-98 sixty year-olds are expected to die over the year
- These high levels of improvements can be seen at most ages and cumulatively are material
- Improvements of 2-3% over a 10 year time horizon mean that after 10 years, 20-30% fewer people are expected to die at the ages in question

Source: Swiss Re calculations

US life expectancy has been increasing and increases show no sign of slowing down
Canadian Life expectancy continues to improve

Canadian life expectancy has been increasing and increases show no sign of slowing down.

![Annual improvements in male mortality rates (Canada)](image)

- For example, sixty year-olds in 2001 showed an improvement of 2-3%.
- This means that, if at the start of 2001, 100 sixty year-olds were expected to die over the year, at the end of 2001, only 97-98 sixty year-olds are expected to die over the year.
- These high levels of improvements can be seen at most ages and cumulatively are material.
- Improvements of 2-3% over a 10 year time horizon mean that after 10 years, 20-30% fewer people are expected to die at the ages in question.

Source: Swiss Re calculations
US Male Mortality Improvement

Wealthy States*  Median income
1. New Hampshire  $65,028
2. New Jersey      $64,918
3. Connecticut     $64,644
4. Maryland        $63,828
5. Alaska          $62,675
6. Virginia        $61,126
7. Utah            $60,396
8. Massachusetts    $59,732
9. Hawaii          $58,469
10. Washington     $58,404

Poor States*  Median income
1. Mississippi    $35,693
2. Arkansas       $37,987
3. West Virginia  $39,170
4. Tennessee      $40,034
5. South Carolina $41,548
6. Montana        $41,587
7. Kentucky       $41,828
8. Alabama        $42,144
10. Louisiana     $42,423

* US census bureau report 2010
Material Financial Impact
Sensitivity of liabilities to mortality improvements

<table>
<thead>
<tr>
<th>Change in mortality improvement p.a.</th>
<th>1%</th>
<th>2%</th>
<th>3%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dave's Annuity Sensitivity</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Liability change</td>
<td>4.4%</td>
<td>9.4%</td>
<td>15.3%</td>
</tr>
<tr>
<td>Life Expectancy change yrs</td>
<td>1.1</td>
<td>2.5</td>
<td>4.2</td>
</tr>
</tbody>
</table>

* Dave – level benefit, using 100% UP94 with Scale AA improvements and discount rate of 4%
Canadian Mortality Improvement
## Canadian Valuation Assumptions are Puzzling

Fill in the blank...

### Canadian Male Change in mortality improvement p.a.

<table>
<thead>
<tr>
<th>Scenario</th>
<th>What's Next?</th>
<th>Scale AA +0%</th>
<th>Scale AA +1%</th>
<th>Scale AA +2%</th>
<th>Scale AA +3%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Canadian Male Change</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>in mortality improvement p.a.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

- 4.0% - 5.0%
- 3.0% - 4.0%
- 2.0% - 3.0%
- 1.0% - 2.0%
- 0.0% - 1.0%
- -1.0% - 0.0%
Canadian Valuation Assumptions are Puzzling
Fill in the blank...

<table>
<thead>
<tr>
<th>Scenario</th>
<th>What's Next?</th>
<th>Scale BB +0%</th>
<th>Scale BB +1%</th>
<th>Scale BB +2%</th>
<th>Scale BB +3%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Canadian Male Change in mortality improvement p.a.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

The table above shows the impact of different scenarios on mortality improvement. The color codes indicate the percentage change, with different ranges represented by distinct colors:

- Red: 4.0% - 5.0%
- Orange: 3.0% - 4.0%
- Yellow: 2.0% - 3.0%
- Green: 1.0% - 2.0%
- Blue: 0.0% - 1.0%
- Grey: -1.0% - 0.0%
Canadian Mortality Improvement
CPM-B vs. Scale AA

#1 CPM-B

#2 Can Scale AA


4.0%-5.0%
3.0%-4.0%
2.0%-3.0%
1.0%-2.0%
0.0%-1.0%
-1.0%-0.0%
-2.0%--1.0%
US Mortality Improvement
## Scale AA Mortality improvement

<table>
<thead>
<tr>
<th>Scenario</th>
<th>What's Next</th>
<th>Scale AA +0%</th>
<th>Scale AA +1%</th>
<th>Scale AA +2%</th>
<th>Scale AA +3%</th>
</tr>
</thead>
<tbody>
<tr>
<td>US Male Change in mortality improvement p.a.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

![Color-coded map of mortality improvement](image)

Legend:
- **5.0%-10.0%**
- **4.0%-5.0%**
- **3.0%-4.0%**
- **2.0%-3.0%**
- **1.0%-2.0%**
- **0.0%-1.0%**
- **-1.0%-0.0%**
# Scale BB Mortality Improvement

<table>
<thead>
<tr>
<th>Scenario</th>
<th>What's Next?</th>
<th>Scale BB +0%</th>
<th>Scale BB +1%</th>
<th>Scale BB +2%</th>
<th>Scale BB +3%</th>
</tr>
</thead>
<tbody>
<tr>
<td>US Male Change in mortality improvement p.a.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Legend:
- 5.0% - 10.0%
- 4.0% - 5.0%
- 3.0% - 4.0%
- 2.0% - 3.0%
- 1.0% - 2.0%
- 0.0% - 1.0%
- -1.0% - 0.0%
Mortality Improvement Changes

#1 MP2014

#2 Scale AA
Longevity Model Musings
"Garçon ! There is a fly in my DNA!"

Technical vs. Fundamental

Actuarial Models are driven by historic data, where we generate statistics which we use to predict future outcomes.

These models are very different from those used in physical life sciences and medicine, where we want to know HOW and WHY something is working and improve it or fix it if it is broken.

For example... Genetic Studies with Drosophila (Fruit Fly)*

Canadians

• Dr Michael Rose, Evolutionary Biologist - Demonstrated increased longevity in Drosophila through breeding in 1991.

• Dr Gabrielle L. Boulianne, Ph.D., Sick Kids Hospital, Canada Research Chair in Mol. Dev. Neurobiology - SOP Gene increased longevity by 40%.

Very Recent:

  - Showed that over expression of PGC-1 Gene delayed aging of intestines and extended longevity by 33%.

*Image credit – Nature Genetics at www.nature.com
Longevity Models Strong Enough to Attract Capital

Technical Models
- Actuarial
- Risk Pricing
- Math
- Statistics

Fundamental Models
- How it works
- Mechanics
- Fidelity
- Understanding
- Clinical

Pricing Risk with Confidence

Quantify the price of risk

Articulate how a physical body ages
Longevity Risk Transfer
Two Styles of Solution

<table>
<thead>
<tr>
<th>Insurance &quot;Indemnity&quot; Solutions</th>
<th>Investment &quot;Index&quot; Solutions</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Longevity Insurance</strong></td>
<td></td>
</tr>
<tr>
<td>Complete Longevity Risk Transfer through indemnity coverage</td>
<td><strong>Longevity Swaps</strong></td>
</tr>
<tr>
<td><strong>Buy Ins</strong></td>
<td>Investments that are negatively correlated with longevity risk embedded in life annuities and pension liabilities</td>
</tr>
<tr>
<td>As above with full upfront payment</td>
<td>Index population based - basis risk</td>
</tr>
<tr>
<td><strong>Buy Out</strong></td>
<td>ISDA / LLMA</td>
</tr>
<tr>
<td>Existing Assets and Liabilities are transferred to Insurance company</td>
<td><strong>Cat Bonds, Mortality Bonds, Micro Longevity</strong> - cash, bespoke, index</td>
</tr>
<tr>
<td>• Offered by Insurance/ Reinsurance companies</td>
<td><strong>Insurance Linked Securities (ILS)</strong> (where performance is uncorrelated on a buy and hold basis with debt and equity markets)</td>
</tr>
</tbody>
</table>
| • Transfer Liabilities
Longevity (Re) Insurance
Replace uncertain liabilities with a known annual premium schedule

Pension Plans cannot budget and invest for the future with this degree of uncertainty.

Uncertain annual cashflows over an unknown future timeframe become certain annual insurance premiums over a known premium term.
Mechanics - How does longevity insurance work?

Certainty

Pension Plan makes the same fixed premium payments regardless of changes in longevity

Swap Format

(Re) Insurer covers the cost if longevity increases, and gains if longevity decreases
Structure and key features

- No cash outlay. Assets stay with Pension Plan
- Pension Plan maintains relationship with Pensioners
- Benefits are unaltered
- Premium amounts are defined in contract at outset
- Complete longevity risk transfer – no basis risk
- Sits alongside other risk management solutions – e.g. LDI
- Settlement mechanism mitigates Credit Risk
Key Messages

Longevity Risk is Real

• There is a well defined global upward trend in life expectancy and mortality improvement.

Longevity Risk has Material Financial Impact

• A one year change in life expectancy (a 1% change in mortality improvement) translates into a 4% change in plan liabilities.

There are Practical Solutions for Managing Longevity Risk

• There are practical tools to manage the risk of retirees outliving their finances.
Thank you
Legal notice

©2014 Swiss Re. All rights reserved. You are not permitted to create any modifications or derivatives of this presentation or to use it for commercial or other public purposes without the prior written permission of Swiss Re.

Although all the information used was taken from reliable sources, Swiss Re does not accept any responsibility for the accuracy or comprehensiveness of the details given. All liability for the accuracy and completeness thereof or for any damage resulting from the use of the information contained in this presentation is expressly excluded. Under no circumstances shall Swiss Re or its Group companies be liable for any financial and/or consequential loss relating to this presentation.