Longevity Risk in Annuities and Life Insurance

Presentation to the Financial Stability Oversight Council Nonbank Designations Committee
Insurance Industry Working Group
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Agenda Topics

- Summary of Task Force presentation to the NAIC's Life Actuarial Task Force
  - Created Task Force Charge and Working Definition of "Longevity Risk" (LRTF)
- Analysis of U.S. Mortality Trends
- Review of Regulatory Approaches to Longevity Risk
- Review of Company Approaches to Longevity Risk
- Preliminary Modeling Exercise
- Initial Conclusions

LRTF's Definitions

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LRTF's Defined Objective

The subgroup will evaluate current U.S. and international practices for considering longevity risk in reserves and required capital for life and annuity products, and form a recommendation as to how an explicit longevity risk margin should be incorporated into statutory reserve requirements, risk-based capital (RBC) requirements, or both. At this time the group will focus on a conceptual framework for such a margin, and will not make any recommendations as to the detailed, specific methodology or calculation for determining the margin. Considerations will include the following, and will be part of the documentation supporting the ultimate recommendation:

- The nature and scale of longevity risk in various insurance products currently sold
- Approaches used in other jurisdictions, including underlying rationale (note: this item will be reviewed early in the process)
- Approaches used by insurance company management to evaluate the risk
- Margins included in current statutory reserves
- Diversification benefits associated with mortality risk
- Severity, volatility, and speed of onset of the financial impact of longevity risk

LRTF's Definition of Longevity Risk

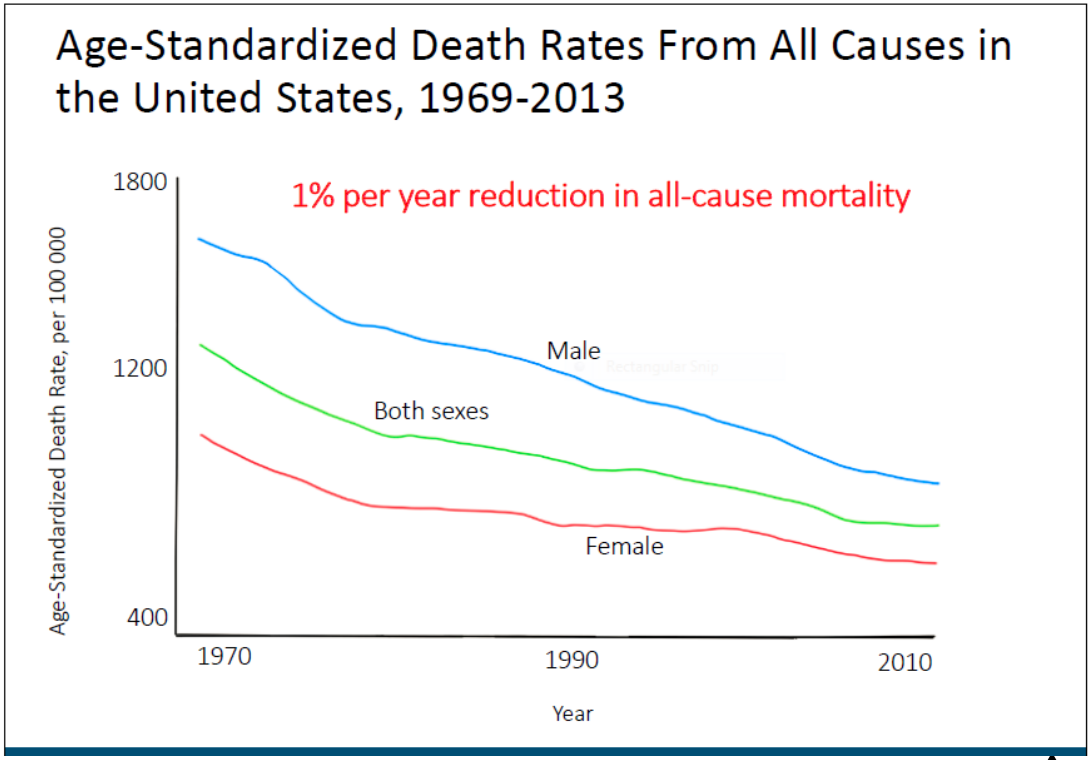
Longevity risk is the risk of loss to the insurer due to policyholders living longer than expected, considered over the lifetime of the business. It includes:

- Mortality improvement volatility (trend risk)
- Volatility around base table (basis risk)
- Mortality volatility by cause of death (extreme long term events)
- Selection effect (underwriting "wear off") volatility

Some risks (e.g., pandemic) affect both life and annuity blocks and generate offsets. Other risks (e.g., selection effect) may not.

U.S. Mortality Trends Analysis

U.S. Historical Rates of Death



Source: Ma J et al, JAMA. 2015 Oct 27;314(16):1731-9

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U.S. Historical Mortality Improvement

FIGURE 4: ANNUAL MORTALITY IMPROVEMENT - MALE
U.S. POPULATION FIVE-YEAR MOVING AVERAGE 1960-2010

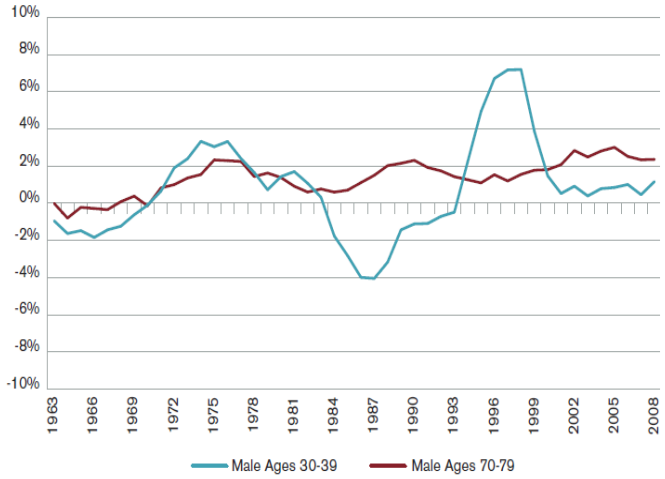
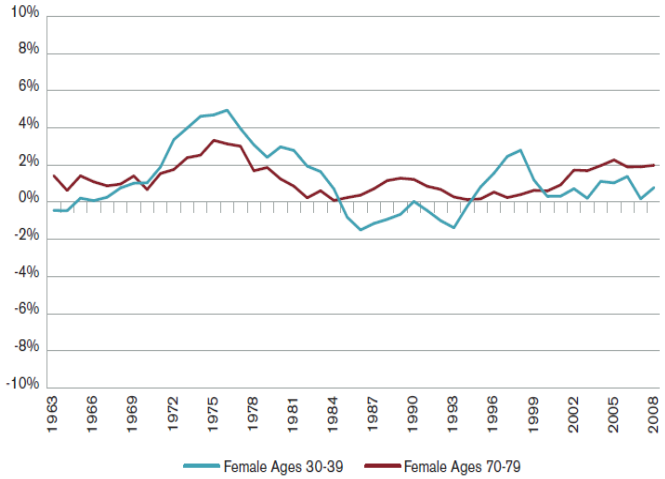


FIGURE 5: ANNUAL MORTALITY IMPROVEMENT - FEMALE
U.S. POPULATION FIVE-YEAR MOVING AVERAGE 1960-2010



Source: Milliman, “Diversification of mortality and longevity risk”

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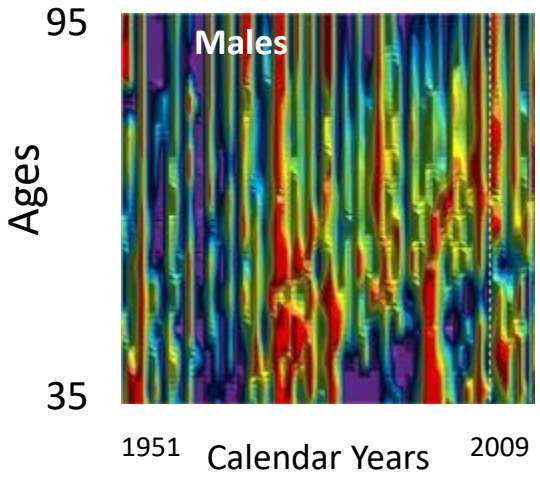
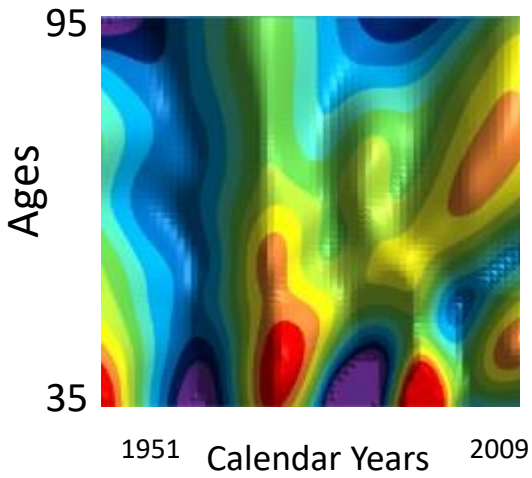
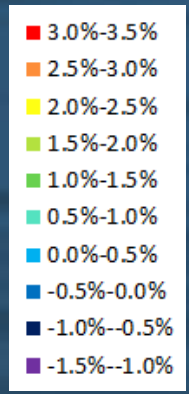
U.S. Historical Mortality Improvement

Unsmoothed SSA mortality data



Graduated SSA mortality data





Source: Society of Actuaries, Mortality Improvement Scale, MP-2015 Report, October 2014

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Mortality Observations

- There is a clear trend of mortality improvement over the past 50 years
- The level of mortality improvement varies significantly by age, gender, and time period
- There are some time periods for which certain ages and genders have exhibited mortality deterioration

Regulatory Approaches to Longevity Risk

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Scope of Regulatory Review

- Researched reserve and required capital methods to capture longevity risk in the following jurisdictions:
  - Regulations currently in effect for U.S. (reserves only), Europe Solvency II, Japan, China, Mexico, Australia, Bermuda, Brazil
  - New Regulations in various phases of analysis for IAIS, Canada, Japan, and Chile
- Jurisdictions cover ~85% of the global life insurance market

Summary - International

- Most common approach: reserves based on unlocked best estimate assumptions + explicit reserve margin; capital based on longevity-shocked liabilities above best-estimate liabilities
  - Capital shocks applied only to products with longevity risk
  - Capital diversification with life insurance benefits via correlation matrices
  - Longevity risk viewed over life of business
- Some regimes express longevity capital using a simplified and static % of reserves approach for products with longevity risk

Summary - International (cont.)

- Regimes with Solvency II influences distinguish between
  - Mis-estimation of current mortality levels
  - Mis-estimation of trend (improvement assumption)
  - Volatility of mortality rates
- Solvency II standard formula – flat 20% reduction of qx; larger companies use more sophisticated internal models
- No distinctions between cause of mis-estimation from large medical breakthroughs versus incremental improvements since risk is for the life of business
- 99.5% shocks used in Solvency II are not directly transferrable to U.S. RBC since target capital levels are typically 125-150% of minimum rather than 300-450% RBC target levels for U.S.

Summary – U.S. Statutory

- Statutory reserves cover moderately adverse longevity risks; many companies include longevity risk in asset adequacy analysis. AG43 for variable annuities explicitly requires consideration of longevity risk.
- While RBC covers risks in excess of reserves, RBC does not include a longevity risk charge for life insurance or annuities.
- NAIC Own Risk & Solvency Assessment (ORSA) provides the framework for describing the impact of longevity risk based on an individual insurer's unique risk profile.

U.S. Statutory Policy Reserves

- Statutory policy reserves are calculated as formulaic reserves plus any additional reserves established in asset adequacy testing
- Existing policy reserves are intended to cover expected losses that arise under moderately adverse conditions
  - implicitly assumed to occur at one standard deviation (roughly the 84th percentile for normally distributed risks)
  - Individual company results will vary
- Principle-based reserves are set at Conditional Tail Expectation (CTE) 70, accepted as being more conservative than the 84th percentile.

U.S. Stat Valuation Mortality Assumptions

- Valuation mortality used in formulaic reserves includes margins, but those margins are generally static.
- Some valuation tables include specific provision for mortality improvement (e.g., group annuitant mortality and the most recently adopted individual annuitant mortality table).
- Surveys show that many companies reflect longevity risk in the asset adequacy testing for products with material longevity risk. Actuarial practice suggests that longevity risk needs to be included in asset adequacy testing for moderately adverse conditions.
- AG 43 for variable annuities with guaranteed benefits indicates that future mortality improvements are to be considered in asset adequacy testing.

Practical Considerations regarding the Stat Valuation Methodology

- Margins
  - How much longevity risk is included in valuation mortality margins?
  - Do margins vary by year of issue? Longevity risk tends to show select/ultimate characteristics.
- Asset Adequacy Testing
  - Is sufficient guidance provided to valuation actuaries on how to reflect longevity risk?
  - Should sensitivity testing be part of the analysis?
- Correlation of Longevity Risk with Other Risks
  - Interest rates will affect the impact of longevity risk.
  - How should longevity risk be correlated with other (e.g., financial) risks?

U.S. Risk-Based Capital Requirements

- Required capital is an add-on to policy reserves under the assumption that policy reserves are adequate; RBC factors were established to capture risk levels above the levels captured in policy reserves.
- Life RBC formula captures the effects of risks that could materialize over a short to medium time horizon.

Life RBC Formula Details

- C2 factors establish minimum capital requirements to address the risks associated with the deterioration of mortality and/or morbidity experience.
- Current C2 factors were developed from a combination of stochastic, risk theoretical and empirical approaches for the major lines of life insurance business.

C2 Factors

- Include the risks of inadequate pricing, random fluctuation, catastrophic events such as influenza pandemics and AIDS, and a "contagion" that creates a sudden deterioration in experience.
- Also include secular shifts over time and cyclical fluctuations in morbidity experience, but have less impact on solvency due to their slower emergence.
- Longevity risk was not reflected in C2
  - assumed to be immaterial in the late 80s/early 90s.
  - intentionally excluded due to its slow emergence.
  - considered to be a risk that can be managed by the company through reserves.

C2 Factors

- For life insurance, C2 = Factor * Net Amount at Risk
- For Annuities, C2 = 0
- For long-term care (LTC), C2 factors vary by premium and claim volumes.
  - Consistent with disability income and other lines of business, C2 factors were developed to mitigate a 5% insolvency probability over a five year period.
  - The C2 LTC factors were adopted by the NAIC in 2005.

C3 Market Risk

- C3 captures market risk due to fluctuations in interest rates and equity returns.
- The C3 requirement for life insurance is calculated as a factor times reserves.
- The C3 requirement for annuities is calculated from a stochastic modeling of cash flows, using individual company models. No specific guidance or requirement defines how longevity risk is reflected in the cash flows.

Life RBC and Longevity Risk (cont.)

- What sources of longevity risk should be covered by life RBC? Only mortality improvement from trend risk? Exclude other sources of mortality improvement?
- Regulators define the statistical safety level (SSL) for RBC factors.
  - C2 factors for individual life insurance are set at a 95% confidence level over a five year period.
  - C2 factors for group life insurance are set at a 95% confidence level over a three year period.

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Life RBC and Longevity Risk (cont.)

- What is an appropriate SSL for a longevity risk charge? 10 years? Lifetime of the business?
- Is CTE an appropriate metric for longevity risk?
  - CTE creates a bias against longer duration products in favor of shorter duration products
  - The implicit confidence level for year one of a projection is dramatically higher for a 50-year horizon than it is for a much shorter horizon.
  - The implicit confidence level for every "overlapping projection year" is higher for the product with the longer time horizon.
- How should risk offsets and risk correlation be reflected in life RBC?
  - Life insurance and annuity offsets
  - Longevity and financial risk correlation

Longevity Risk and ORSA

- Certain aspects of longevity risk analysis not included in reserves or RBC might be captured in ORSA.
- ORSA can show the impact of longevity risk on an insurer's unique risk profile using stress testing, or some other technique.
- ORSA can show the impact of longevity risk over different time horizons (5-10 years vs. product lifetime).
- Some mortality improvements are difficult to project (e.g., impact of bio-technology) and possible impact could be demonstrated via sensitivity analysis.

Review Summary – U.S. Treatment

LTRF View of Treatment for the Following Products*	Longevity Risk in Formula Reserve	RBC Charge for Longevity Risk
Fixed Deferred Annuity (FDA)	Yes, since 2015**	Partial (C-3)***
Fixed Deferred Annuity with Living Benefit (GLWB)	Yes, since 2015	Partial (C-3)
Indexed Deferred Annuity	Yes, since 2015	No
Indexed Deferred Annuity with Living Benefit (GLWB)	Yes, since 2015	No
Variable Deferred Annuity	Yes	Partial (C-3)
Variable Annuity with Death Benefit (GMDB)	Yes	Partial (C-3)
Variable Annuity with Living Benefit	Yes	Partial (C-3)
Contingent Deferred Annuity	Yes	Partial (C-3)
Immediate Annuity	Yes, since 2015	Partial (C-3)
Deferred Income Annuity	Yes, since 2015	Partial (C-3)
Supplemental Agreement under FDA or Life Insurance	Yes, since 2015	Partial (C-3)
Structured Settlement Annuity and Substandard Annuity	Yes, since 2015	Partial (C-3)
Pension Buyout	Yes, since 2015	Partial (C-3)
Longevity Swap	NA	No
Lapse Supported Life Insurance	No	No
Other Life Insurance	NA	NA

Red indicates newer products the LTRF views as having relatively high longevity risk

* *Only life and annuity products are in scope currently. Scope may expand in the future to include: long-term care, disability income (including riders), life Insurance/annuity and LTC combination products*

** *Applied for business issued 2015 and later. Note there could also be some margin in the base table*

*** *Some effect captured in stochastic analysis, but excludes any explicit stress to longevity*

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Mortality Assumption Regulatory Requirements

	Minimum requirement		Improvement requirement	
Country	Annuity Providers	Pension Plans	Annuity Providers	Pension Plans
Brazil	No	Yes	No	No
Canada	No	Yes	Yes	Yes
Chile	Yes	Yes	Yes	Yes
China	Yes	Yes	No	No
France	Yes	Yes	Yes	Yes
Germany	Yes	Yes/No	Yes	Yes
Israel	Yes	Yes	Yes	Yes
Japan	No	Yes	No	No
Korea	No	No	No	No
Mexico	Yes	No	Yes	No
Netherlands	No	No	Yes	Yes
Peru	Yes	Yes	No	No
Spain	No	No	Yes	Yes
Switzerland	No	No	No	No
UK	No	No	Yes	Yes
U.S.	Yes	Yes	No	Yes

Source: OECD, Mortality Assumptions and Longevity Risk Implications for pension funds and annuity providers, 2014

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Company Approaches to Longevity Risk

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Emergence of Longevity Risk

Longevity risk typically emerges over a fairly long period of time, which may be different than most capital market risks (e.g., credit):

- **Cash Flow Impact** – Builds slowly over time as higher longevity is realized
- **Reserve Impact** – Reflected sooner than cash flow as Asset Adequacy Testing reflects changing expectations of future longevity
- **Ultimate Economic Impact** – Greatest possible impact since early reserve adjustments may not fully anticipate ultimate mortality improvements under a stress scenario

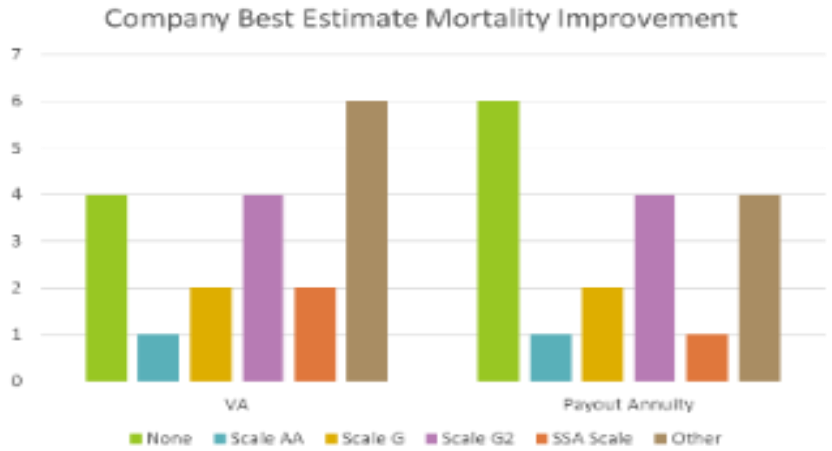
Views of Longevity Risk

Insurers view longevity risk under different lenses:

- **Liquidity Lens** – Longevity risk viewed as immaterial
- **Short-Term Solvency Lens** – Considers near-term statutory reserve/capital implications from changes to future longevity expectations
- **Long-Term Economic Lens** – Considers long-term cash flow implications under a severe longevity scenario even though the full impact to cash flows often occurs over many years

Use of Mortality Improvement

- Mortality improvement assumptions vary among companies
- It is important to consider liability assumptions in aggregate to determine adequacy of reserves and capital – a company using no mortality improvement may still have reasonable liability estimates considering other assumptions (such as conservatism in base mortality tables).



Source: E&Y survey of best estimate mortality improvement assumptions

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Typical Approaches Used by Companies

Are mortality improvements typically included in market practices?

Country	Annuity Providers	Pension Plans
Brazil	No	No
Canada	Yes	Yes
Chile	Yes	Yes
China	No	No
France	Yes	Yes
Germany	Yes	Yes
Israel	Yes	Yes
Japan	Yes	No
Korea	No	No
Mexico	Yes	No
Netherlands	No	No
Peru	Some	Some
Spain	Yes	Yes
Switzerland	Yes	Some
UK	Yes	Yes
US	Yes	Yes

Source: OECD, Mortality Assumptions and Longevity Risk Implications for pension funds and annuity providers, 2014

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Preliminary Results, Observations, and Initial Conclusions

Longevity Risk Observations

- Insurers' exposure to longevity risk has increased as product design and features have evolved
- The continued low interest rate environment exacerbates the impact of an insurers' exposure to longevity risk
- Historical mortality experience demonstrates that a "tail" stress could be represented by an annual improvement level somewhere in the 2% to 3% range
- An extreme stress to longevity risk over the life of a typical annuity product may result in a material change in the present value of cash flows.
- The relationship of longevity and mortality risk is important (for example, if longevity risk is added to RBC, base C2 factors should be updated for consistency)
- Jurisdictional differences in regulatory treatment of the risk can lead to regulatory arbitrage activities

Initial Conclusions

1. The industry's exposure to longevity risk has increased over time, is likely to continue to increase, and the risk should be appropriately captured in reserves and capital.
2. In the current environment, asset adequacy testing is the appropriate approach to ensure reserve sufficiency under moderately adverse outcomes, considering longevity and other risks. More specific guidance for the appointed actuary may be needed.

Initial Conclusions (continued)

3. A capital charge for longevity risk within RBC may be warranted.
   a. Although RBC is intended to protect solvency from rapid deterioration over a 5-10 year horizon, it is important to understand the resulting impact of such deterioration on longevity risk over an entire product lifetime.
   b. Longevity capital should consider the presence of reserve margins for longevity risk (i.e., to avoid double counting).
   c. Capital for longevity should reflect the covariance of longevity with other risks, such as interest rate risk.
   d. Calibration of a loss distribution and ultimate capital charge for longevity risk requires substantial additional work and ultimately significant judgment, given the uncertain impact of key drivers of future mortality improvement rates, such as medical and safety advances.

Questions?

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Appendix 1 - Conclusion Details

Initial Conclusions - Considerations

- RBC is intended to protect solvency from rapid deterioration over a time horizon typically 5 to 10 years. While additional cash payments attributable to unexpected longevity over that horizon may not cause rapid deterioration, the higher resulting reserve levels could be significant, especially if compounded by assumption changes reflecting the mortality improvement occurring over the 5-10 year period. However, RBC charges attributable to future reserve assumption changes would be a departure from the existing framework applied for most risks.
- Preliminary hypothetical testing suggests that longevity risk warrants further analysis. Significant effort will be required to determine how to develop and support the necessary assumptions, and to develop guidance for actuaries performing this work. For example, many combinations of variations in mortality improvement and underlying mortality can produce a given mortality result. Thus, long time horizons are required for experience studies.
- Determining available margins in current reserves would require asset adequacy analysis, with guidance on how to determine consistent conservatism for all assumptions, and how to allocate the resulting margins to risk categories without double counting.
- Covariance adjustments may need to be considered
- Analyses performed in other jurisdictions, such as Canada and Europe, can be helpful starting points in working to define U.S. requirements.

Initial Conclusions - Considerations

- Recent reserve and RBC updates have generally been at a CTE 70 level of conservatism for reserves, and CTE 90 for RBC. Continuing this framework seems reasonable for Longevity Risk.
- Continuation of the "Total Asset Requirement" (TAR) framework, where the RBC requirement is set to TAR minus Reserves, can accommodate variation in the degree of margins available in reserves.
- Current C2 requirements were developed using stochastic analysis, on a "typical company model office" basis, to develop simple factors to apply to net amount at risk. A similar approach could be used to develop initial factors for longevity risk.
- Current C3 requirements include a factor-based or standard scenario floor, and stochastic testing to assess the need for RBC above the floor. Hypothetical modeling, or a field test, could be used to help determine whether this approach is needed for longevity risk.
- C2 development for mortality risk was modeled over 3 years for group life and 5 years for ordinary life. C3 testing extends over the effective lifetime of the relevant business. Applying the same level of conservatism, such as CTE 90, to such a wide variation of projection periods can produce very different levels of conservatism over the 5 to 10 year horizon for which RBC is designed. This topic should be examined further.
- The interplay of market risks with longevity risk can have material effects, and possibilities such as integrated C2 and C3 testing should be evaluated.

Appendix 2 –Supporting Materials

Current Products*

Further details regarding products with longevity risk and U.S. treatment of the risk in reserves and capital:

Product	Nature & Scale of Longevity Risk	Recognition in Reserves (Margins)	Recognition in Capital
Fixed Deferred Annuity (FDA)	• Longevity risk is from guaranteed annuitization rates. • Assumed mortality ranges from liberal to conservative. • Utilization very low.	• Reserved under AG33, recognizing annuitization at "worst case" utilization. • Static mortality assumed under various dated tables for issues prior to 2015; generational mortality in 2012 IAM table for subsequent business. • Valuation mortality is related to "self-selected" SPIA experience so is conservative for this business.	None
Fixed Deferred Annuity with Living Benefit (GLWB)	• Additional longevity risk is from the increase in the probability that withdrawals will deplete the account value and then payments continue. • The risk is partly mitigated (magnified) if account value growth is strong (weak), if benefit base increases are not tied to account value growth. • Very few such contracts exist currently but this may soon become an area of industry growth due to DOL's new Conflict of Interest regulation.	• Reserved under AG 33, with additional stream(s) for living benefits. • Reserving requirement for GLWBs is conservative due to assumption of "worst case" utilization and no lapses. • Valuation mortality is the same as for Fixed Deferred Annuity (see above).	None
Indexed Deferred Annuity	• Same as FDA. • Most Indexed Deferred Annuities are issued with GLWB, so longevity risk from annuitization rates alone is low.	• Reserved under AG35, otherwise same as for Fixed Deferred Annuity. • Valuation mortality is the same as for FDA (see above).	None
Indexed Deferred Annuity with Living Benefit (GLWB)	• Same risk as FDA with Living Benefit • This is the predominant form in which indexed annuities are issued today.	• Reserved under AG 33 and AG 35 with stream for living benefits. • Reserving requirement same as for Deferred Annuity with Living Benefit. • Valuation mortality is the same as for FDA (see above).	None

** Only life and annuity products are in scope currently, with intent to expand in the future*

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Current Products (cont.)

Product	Nature & Scale of Longevity Risk	Recognition in Reserves (Margin)	Recognition in Capital
Variable Deferred Annuity	• Same as Fixed Deferred Annuity for fixed annuitization guarantees. • Variable income factors, where available, do not have conservative interest assumption to offset the embedded mortality and expense guarantees, but utilization has also been very low.	• Reserved under AG 43, in which mortality improvement should be recognized. • Requirement of "prudent assumptions" introduces some conservatism.	Capital determined by C3-Phase II. Mortality recognition similar to AG 43.
Variable Annuity with Death Benefit (GMDB)	• Additional mortality risk due to death benefit guarantee. • Increased longevity initially decreases the mortality risk, but could increase or decrease overall risk in long term.	• Same as Variable Deferred Annuity (VDA)	Same as VDA
Variable Annuity with Living Benefit	• Longevity risk with a GLWB is the increase in the probability that withdrawals will deplete the account value and then payments continue. • With a GMIB, the risk is that the annuitant will have a long life after exercise of the GMIB. • In either case, the risk is mitigated (magnified) if account value growth is strong (weak).	• Same as VDA	Same as VDA
Contingent Deferred Annuity	• The risk is the same as for a Variable Annuity with a GLWB.	• Same as VDA, with small adjustments to Standard Scenario to recognize product differences.	Same as VDA, with small adjustments to Standard Scenario for product differences.
Immediate Annuity	• Risk is from mortality improvement beyond what is assumed in pricing and/or reserving. • Scale of risk may vary depending on the election of benefits with significant death benefits or guarantee (certain) periods.	• Reserved under CARVM with static mortality under various dated tables for issues prior to 2015; generational mortality in 2012 IAM table for subsequent business.	None
Deferred Income Annuity	• Same as Immediate Annuity, but the variability may be greater due to the elimination of benefits in the early years.	• Same as Immediate Annuity.	None

Current Products (cont.)

Product	Nature & Scale of Longevity Risk	Recognition in Reserves (Margin)	Recognition in Capital
Supplemental Agreement under Deferred Annuity or Life Insurance	• Same as Immediate Annuity.	• Same as Immediate Annuity.	None
Structured Settlement Annuity and Substandard Annuity	• Business includes both standard and substandard underwritten longevity risk. • Risk is that mortality improvement is materially greater or that initial mortality was lower than what is assumed in pricing. • In particular for substandard business, there is considerable financial impact should additional deaths associated with medical impairments not materialize due to improvements to medical care. • Imprecision of longevity underwriting also is a risk.	• Reserved under AG 9a, 9b, and 9c. • Reserves reflect mortality derived from the underwriting process. • Substandard annuity reserving limited to cases with at least 25% additional mortality.	None
Pension Buyout	• Risk of increased liability due to mortality improvement beyond what is assumed in pricing and/or reserving. • This risk may have more variability than individual annuities, due to range and concentration of pension populations with differing income levels and occupations.	• CARVM using 1994 GAR table (margin applied to 1994 GAM table) with Scale AA mortality improvement.	None
Longevity Swap	• Risk is passed from the buyer of the longevity swap to the seller, usually as a hedge. • Buyer and/or Seller may be insurers. • The risk passed to the seller is typically based on the risk in an underlying product that was guaranteed by the buyer, or based on other liabilities of the buyer having longevity risk.	• For an insurer as a buyer, the reserves on underlying products are unchanged by a swap. The swap should be recognized in cash flow testing, since it affects cash flows • For an insurer as a seller, there are no insurance reserves associated with the swap.	None

Company Approach: Improvement Stress

Further details on company approaches to quantifying longevity risk:

Improvement stress can be applied in different ways

- Apply additional improvement shock in addition to best estimate improvement rates – *preserves differences in expected improvements across blocks/countries while applying a more consistent severity stress*
- Apply shock resulting in a specified absolute level of improvement – *ensures a consistent level of stress improvement is reflected across blocks, but may result in overly severe shocks to blocks/countries with lower expected improvements*

Shape of mortality improvement stress considerations

- Age at which improvement rate grades to 0 - consistent with best estimate, or extend stress improvements to higher ages?
- Differences by time horizon
  - Short term driven by volatility in improvement rates
  - Medium term by advances in traditional medical treatments / lifestyle factors
  - Longer term uncertainty increases with potential for genetic advances

Multiple viewpoints are considered in setting the appropriate level of stress

- Capital lens (short term vs long term economic)
- Range of historical improvements over time and across countries
- Stochastic modeling view of tail mortality scenarios
- Cause of death based scenario modeling
- Insurer ratings objective and judgment

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Company Approach: Diversification

Further details on company approaches to reflecting diversification in the quantification of longevity risk:

1. Reduction in Base Mortality risk for larger blocks
   - Base mortality stress considers credibility of experience data
2. Covariance between base mortality and mortality improvement risks
   - Insurer approach generally reflects benefit of low/zero correlation
3. Covariance between mortality improvement risks across cohorts (age, country, socio-economic)
   - Positive correlation in improvements likely across cohorts, but still benefits of diversification within block of business
   - Sophistication of analysis varies and significant judgment required to estimate correlations
   - Generally not explicitly reflected in insurer approach, could be captured in specification of improvement shock
4. Netting benefits between Life (mortality) and Annuity (longevity) business
   - Permanent life insurance with mortality trend risk may provide offset to longevity trend risk
   - Population ages/geographies typically differ so need to estimate correlations across cohorts
   - Not always explicitly reflected in insurer approach
5. Potential covariance between longevity and other risks
   - Approaches generally include correlation benefits with other insurance risks (behavior) as well as with market risks (credit, interest rates)