# Longevity Risk Task Force Update

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# Agenda: LRTF Progress Report

Longevity Risk Task Force Progress Report

- Created Task Force Charge and Working Definition of “Longevity Risk”
- Analyzed U.S. Mortality Trends
- Reviewed Regulatory Approaches to Longevity Risk
- Reviewed Company Approaches to Longevity Risk
- Conducted Preliminary Modeling Exercise
- Developed Initial Conclusions

# LRTF's Definitions

# 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

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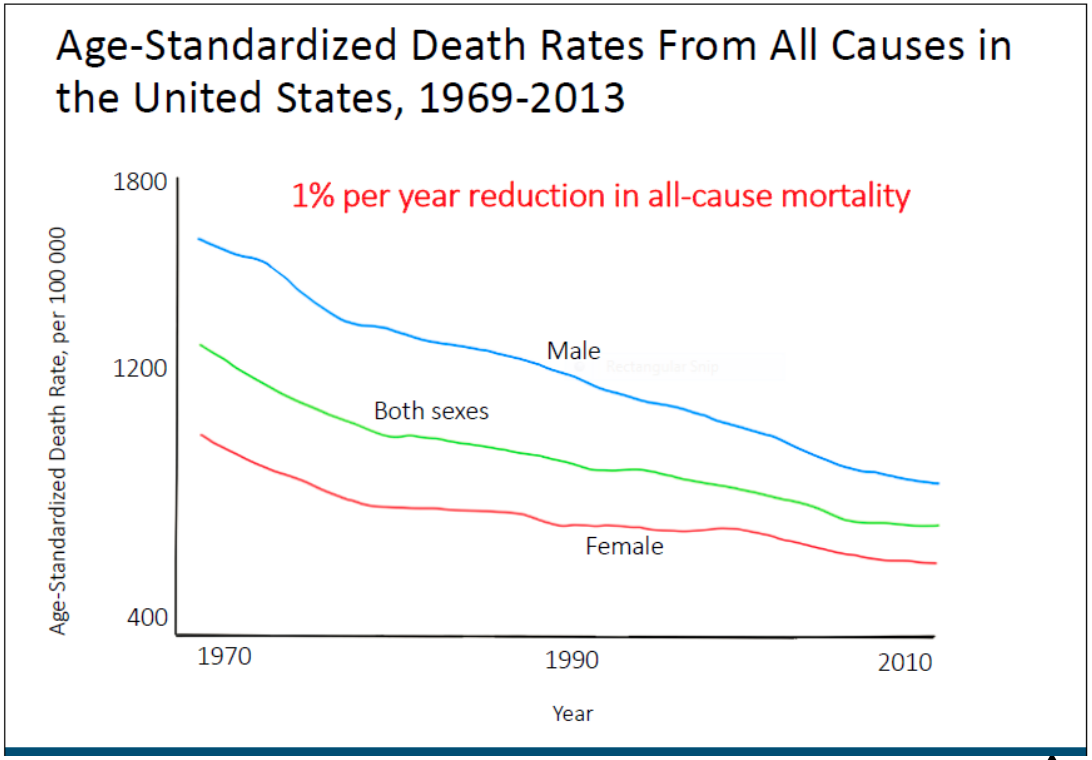
# U.S. Historical Rates of Death




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**

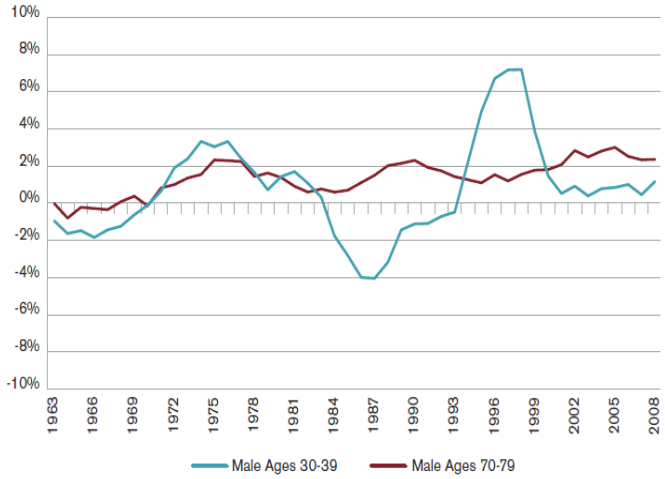
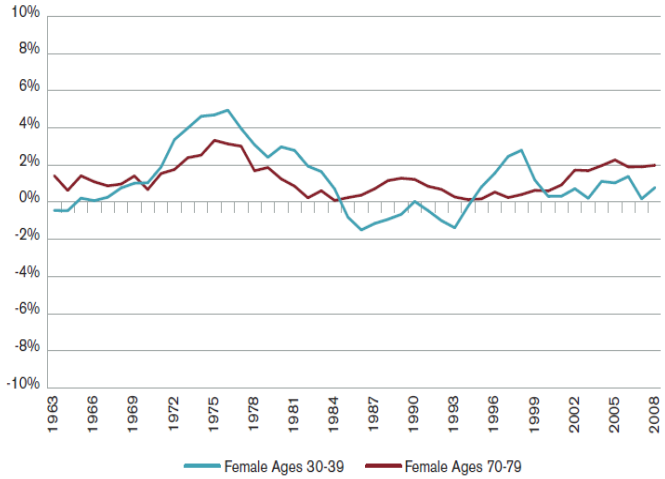



**FIGURE 5: ANNUAL MORTALITY IMPROVEMENT - FEMALE**
**U.S. POPULATION FIVE-YEAR MOVING AVERAGE 1960-2010**




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

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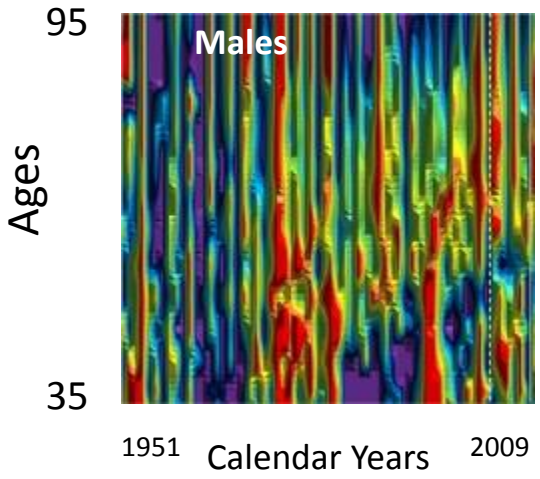
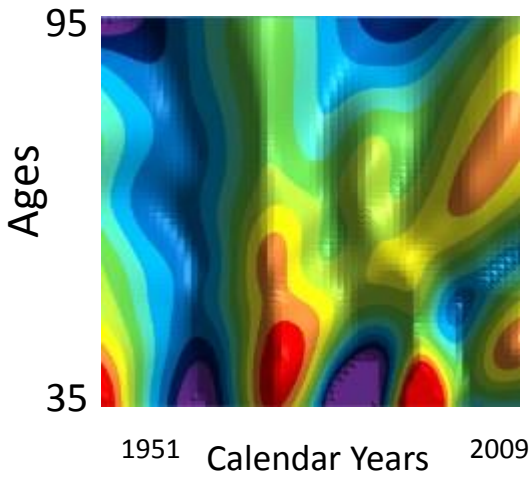
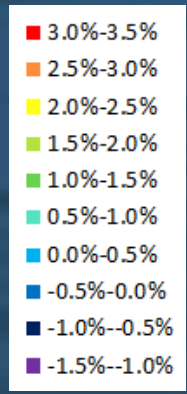
# U.S. Historical Mortality Improvement

**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.
- ORSA provides the framework for describing the impact of longevity risk based on an individual insurer's unique risk profile.

# Summary – U.S. RBC C-2 Factors

- Reflect the risks of inadequate pricing, random fluctuation, catastrophic events
- Longevity risk was intentionally excluded from C-2 factors in late 1980s/early 1990s
  - Assumed to be immaterial
  - Slow emergence
  - Could be managed through reserves

# 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

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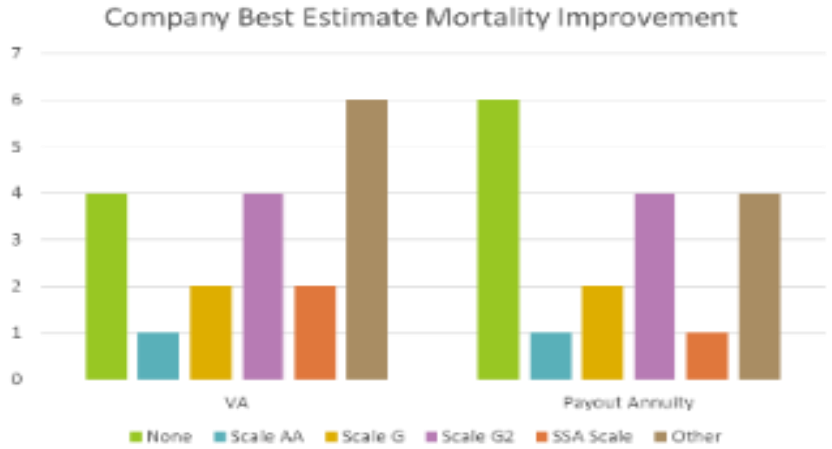
# Views of Longevity Risk

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

# 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 Modeling Exercise

# Modeling Goals

- Task force recognized that looking only at change in claims (i.e., additional annuity payments) over an "RBC horizon" (5-10 years) may not fully capture the risk of adverse longevity events
- If mortality improvement views changed during RBC horizon, appointed actuary would consider increasing reserves, and that increase could be included in a capital charge
- Modeling looks at different approaches to quantifying the impact of a stress event for capital, considering impacts on both payments and reserves

# Modeling Approach

- Model considers different approaches to quantifying the impact of a stress event for capital, considering impacts on both payments and reserves
- Initial Modeled Cell
  - Single Premium Immediate Life Annuity
  - Issue Age/Sex: 70/Female
  - Issue Year/Month: 2017/01
  - Payment Amount/Period: $1000/Year
  - RBC Horizon: 10 Years

# Modeling Bases

- Three Bases Used
  - **Statutory** – Best estimate + provision for adverse deviation (PAD), an "83rd-ile"
  - **Stress** – Best estimate + big PAD, a "95th-ile"
  - **Revised Statutory** – Given stress event, a strengthened statutory reserve basis for a new "83rd-ile"

# Modeling Assumptions

- Mortality Basis: 100% of RP 2014
- Mortality Improvements:
  - Initial Statutory: 1% per year
  - Stress: 2% and 3% per year
  - Revised Statutory: 2% and 3% per year
- Interest Rate: 4% per year

# Modeled RBC Calculation Options

We considered the following definitions of loss for RBC:

1. Horizon Excess Payments only (Excess Pays)
   - Difference between Stress cash flow (CF) and Stat CF
   - Present Value (PV) at Stress Interest Rate
2. Excess Pays + Excess Reserve (Stress Lx*)
   - Includes PV at Horizon Point [Revised Stat – Stat]
   - Both using Stress Lx alive at Horizon Point
3. T = 0: Stress Reserve – Stat Reserve
4. Excess Pays + Excess Reserve (Orig Lx)
   - Includes PV at Horizon Point [Revised Stat – Stat]
5. Excess Pays + Excess Reserves (Stress Lx Rev Stat Res – Orig Lx Stat Res)

Method preferred by LRT to capture increase in reserve at end of horizon

** Lx = remaining lives after decrements*

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# Preliminary LRTF Model Results

Depending on the method and assumptions, RBC ranges from 0.23% to 9.80% of initial stat reserves for a 70-year old female (pre-diversification, pre-tax). Significant additional work is needed to develop a useable model, but these results indicate that longevity risk may be material to RBC.

| Age 70 Female, Stress Scenario | | |
|---|---|---|
| | 2% Improvement | 3% Improvement |
| **Initial Stat Reserve** | **13,271** | **13,271** |
| | | |
| RBC = PV Excess Cash Flow (Choice 1) | 30 | 59 |
| **RBC % of initial reserve** | **0.23%** | **0.44%** |
| | | |
| Extra Reserves | 585 | 1,242 |
| RBC = PV Excess Cash + Extra Reserves (Choice 5) | 615 | 1,301 |
| **RBC % of initial reserve** | **4.64%** | **9.80%** |

# 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 C-2 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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# Thank You

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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.

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# 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 C-2 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 C-3 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.
- C-2 development for mortality risk was modeled over 3 years for group life and 5 years for ordinary life. C-3 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 C-2 and C-3 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.<br>• Assumed mortality ranges from liberal to conservative.<br>• Utilization very low. | • Reserved under AG33, recognizing annuitization at "worst case" utilization.<br>• Static mortality assumed under various dated tables for issues prior to 2015; generational mortality in 2012 IAM table for subsequent business.<br>• 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.<br>• The risk is partly mitigated (magnified) if account value growth is strong (weak), if benefit base increases are not tied to account value growth.<br>• 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.<br>• Reserving requirement for GLWBs is conservative due to assumption of "worst case" utilization and no lapses.<br>• Valuation mortality is the same as for Fixed Deferred Annuity (see above). | None |
| **Indexed Deferred Annuity** | • Same as FDA.<br>• 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.<br>• 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<br>• This is the predominant form in which indexed annuities are issued today. | • Reserved under AG 33 and AG 35 with stream for living benefits.<br>• Reserving requirement same as for Deferred Annuity with Living Benefit.<br>• 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*

# 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.<br>• 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.<br>• 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.<br>• 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.<br>• With a GMIB, the risk is that the annuitant will have a long life after exercise of the GMIB.<br>• 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.<br>• 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.<br>• Risk is that mortality improvement is materially greater or that initial mortality was lower than what is assumed in pricing.<br>• 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.<br>• Imprecision of longevity underwriting also is a risk. | • Reserved under AG 9a, 9b, and 9c.<br>• Reserves reflect mortality derived from the underwriting process.<br>• 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.<br>• 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.<br>• Buyer and/or Seller may be insurers.<br>• 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<br>• 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

# 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)

# Appendix 3 – U.S. Statutory Requirements

# 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 84$^{th}$ percentile for normally distributed risks)
  - Individual company results will vary
- Principle-based reserves are set at CTE 70, accepted as being more conservative than the 84$^{th}$ 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 LR 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? LR tends to show select/ultimate characteristics.
- Asset Adequacy Testing
  - Is sufficient guidance provided to valuation actuaries on how to reflect LR?
  - Should sensitivity testing be part of the analysis?
- Correlation of LR with other risks
  - Interest rates will affect the impact of LR.
  - How should LR 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.
- LRBC 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.

# C-2 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.
- LR was not reflected in C-2
  - 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.

# C-2 Factors

- For life insurance, C2 = Factor * Net Amount at Risk
- For Annuities, C2 = 0
- For 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.

# C-3 Market Risk

- C-3 captures market risk due to fluctuations in interest rates and equity returns.
- The C-3 requirement for life insurance is calculated as a factor times reserves.
- The C-3 requirement for annuities is calculated from a stochastic modeling of cash flows, using individual company models. No specific guidance or requirement defines how LR is reflected in the cash flows.

# LRBC and Longevity Risk (cont.)

- What sources of LR should be covered by LRBC? Only mortality improvement from trend risk? Exclude other sources of mortality improvement?
- Regulators define the statistical safety level (SSL) for RBC factors.
  - C-2 factors for individual life insurance are set at a 95% confidence level over a five year period.
  - C-2 factors for group life insurance are set at a 95% confidence level over a three year period.

# LRBC and Longevity Risk (cont.)

- What is an appropriate SSL for a LR risk charge? 10 years? Lifetime of the business?
- Is CTE an appropriate metric for LR?
  - 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 LRBC?
  - Life insurance and annuity offsets
  - LR and financial risk correlation

# Longevity Risk and ORSA

- Certain aspects of LR analysis not included in reserves or RBC might be captured in ORSA.
- ORSA can show the impact of LR on an insurer's unique risk profile using stress testing, or some other technique.
- ORSA can show the impact of LR 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.