Correlation in Capital Frameworks

Comparison of Correlation in Other Regulatory Capital Frameworks
Life Investment and Capital Adequacy Committee

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Background

- Earlier this year, the Committee suggested to Life Risk-Based Capital (E) Working Group (LRBCWG) that correlation be considered under Life RBC

The LRBCWG requested a comparison of correlation within LRBC to other regulatory capital frameworks

- These materials include correlation assumptions for the European Solvency II, Bermuda BSCR and Canadian LICAT frameworks

- We also share our observations on key similarities and differences as it pertains to a review of correlation within LRBC

Review of historical data is underway, and we expect to be able to share initial numerical results at a future meeting

Current Life Risk Based Capital

RBC after Covariance =

C0 + C4a + Square Root of [(C1o + C3a)^2 + (C-1cs + C-3c)^2 + (C2)^2 + (C3b)^2 + C4b)^2]

Expressed as a correlation matrix, all correlations are either 0% or 100% except for the nested correlation within C-2 between mortality and longevity:

	C-1cs	C-1o	C-2	C-3a	C-3b	C-3c	C-4b
C-1cs	100%						
C-1o	0%	100%					
C-2	0%	0%	100%				
C-3a	0%	100%	0%	100%			
C-3b	0%	0%	0%	0%	100%		
C-3c	100%	0%	0%	0%	0%	100%	
C-4b	0%	0%	0%	0%	0%	0%	100%

Nested correlation for C-2:

	C-2 Mortality	C-2 Longevity
C-2 Mortality	100 %	
C-2 Longevity	-25%	100 %

Potential Correlation Structure for Life Risk Based Capital

Linear correlation between major risk categories expressed as a correlation matrix

	Credit C-1o, C-3b	Equity Market C-1cs, C-3c	Interest Rate C-3a	Insurance C-2a, C-2b	Business C-4a, C-4b
Credit	1				
Equity Market	TBD %	1			
Interest Rate	TBD %	TBD %	1		
Insurance	TBD %	TBD %	TBD %	1	
Business	TBD %	TBD %	TBD %	TBD %	1

Nested correlation used to combine C risks that fall within each major risk category

- C-2 Insurance Risk today is the result of nested correlation matrix between C-2a mortality and C-2b longevity

	Mortality C-2a	Longevity C-2b
Mortality C-2a	1	-25%
Longevity C-2b	-25%	1

Key Observations from Other Regulatory Frameworks

As previously requested, these materials provide a summary of the correlation frameworks used in other insurance regulatory regimes

(European Solvency II, Bermuda Solvency Capital, Canadian LICAT) as part of the review of correlation within LRBC

1. A nested correlation structure is common across regulatory frameworks
   - This is consistent with the potential structure proposed for LRBC

2. Insurance risk components are defined differently across regulatory frameworks but all 3 reflect correlation between these components
   - Each of the other 3 frameworks includes 7 distinct components of Insurance risk combined with correlations which range from -50% to +75%
   - By comparison, LRBC currently includes only mortality and longevity risk components with a correlation of -25%

3. Correlation between Interest Rate Risk and Equity/Credit Spreads varies depending on whether the binding interest rate stress is up rate or down rate under both the Solvency II and Bermuda capital frameworks
   - The stochastic projection included in the calculation of C-3 does not allow different correlations for up vs down binding stresses

4. The time horizon and targeted statistical safety level vary across regulatory frameworks which may render correlation assumptions not directly comparable across frameworks
   - A 1-year capital framework calibrated to a 99.5% confidence may be comparable to a 95%-96% confidence over a longer 10-year period (for example if every year were independent, $0.995^{10} = 0.9511$)
   - Similarly, correlation assumptions appropriate under a 1-year framework calibrated to a 99.5% level may be higher than correlations appropriate for a framework calibrated to a lower confidence level over a longer period
   - The time horizon considered in LRBC is generally longer term but does vary by risk and is further complicated by the Greatest Present Value of Deficiency approach within C-3 where the time frame considered can vary by scenario tested

Questions?

For more information, please contact:

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Appendix:

Correlations used in Solvency II, BSCR and LICAT

Solvency II

The Solvency Capital Requirement (SCR) standard formula uses a nested correlation structure:

- SCR is the sum of the Basic Solvency Capital Requirement (BSCR) and the Operational risk amount (100% correlation for Operational risk)

- BSCR is the result of correlation between major risk categories: Market, Health, Default, Life and Non-Life

    - **Market** is the result of correlation between risk amounts calculated separately for Equity, Property, Interest Rate, Spread, Currency and Concentration risks as shown on a subsequent page

    - **Life** is the result of correlation between risk amounts calculated separately for Mortality, Longevity, Disability, Lapse, Expenses, Revision and Life Catastrophe risks as shown on a subsequent page

    - **Health** and **Non-Life** categories additionally are the result of correlation from more granularly defined risk amounts (not included in these materials)

The correlation between major risk categories used to calculate the Basic Solvency Capital Requirement (BSCR):

Basic Solvency Capital Requirement

	Market	Health	Default	Life	Non-Life
Market	100%				
Health	25%	100%			
Default	25%	25%	100%		
Life	25%	25%	25%	100%	
Non-Life	25%	0%	25%	0%	100%

Solvency II – Life Risk

The nested correlation matrix for Life risk:

Life

	Mortality	Longevity	Disability	Life Expense	Revision	Lapse	Life Catastrophe
Mortality	100%						
Longevity	-25%	100%					
Disability	25%	0%	100%				
Life Expense	25%	25%	50%	100%			
Revision	0%	25%	0%	50%	100%		
Lapse	0%	25%	0%	50%	0%	100%	
Life Catastrophe	25%	0%	25%	25%	0%	25%	100%

Solvency II – Market Risk

The nested correlation matrix for Market risk:

Market

	Interest Rate	Equity	Property	Spread	Concentration	Currency
Interest Rate	100%					
Equity	0% or 50%	100%				
Property	0% or 50%	75%	100%			
Spread	0% or 50%	75%	50%	100%		
Concentration	0%	0%	0%	0%	100%	
Currency	25%	25%	25%	25%	0%	100%

Interest Rate risk correlations with Equity, Property and Spread are 0% if increasing rates are the binding stress, and 50% otherwise

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Bermuda Solvency Capital Requirement

The Bermuda Solvency Capital Requirement ($BSCR_{Corr}$) uses a nested correlation structure:

- $BSCR_{Corr}$ is the sum of the Basic BSCR, the Operational risk amount, adjustment for non-insurance financial entities and adjustment for loss absorbing capacity of technical provisions and deferred taxes (100% correlation for Operational risk)

- Basic BSCR is the result of correlation between major risk categories: Market, Credit and Long-Term risks

  - **Market** is the result of correlation between risk amounts calculated separately for Fixed Income, Equity, Interest, Currency and Concentration risks as shown on a subsequent page

  - **Long-Term** is the result of correlation between risk amounts calculated separately for Mortality, Stop Loss, Rider, Morbidity, Longevity, Variable Annuity and Other risks as shown on a subsequent page

The correlation between major risk categories used to calculate the Basic BSCR:

Basic BSCR

	Market	Credit	Long Term
Market	100%		
Credit	25%	100%	
Long Term	12.5%	50%	100%

Bermuda BSCR – Market Risk

The nested correlation matrix for Market risk:

Market Risk

	Fixed Income	Equity	Interest	Currency	Concentration
Fixed Income	100%				
Equity	50%	100%			
Interest	0% or 25%	0% or 25%	100%		
Currency	25%	25%	25%	100%	
Concentration	0%	0%	0%	0%	100%

Interest risk correlations with Fixed Income and Equity are 0% if increasing rates under the shock-based approach are the binding stress, and 25% otherwise

Bermuda BSCR – Long Term Risk

The nested correlation matrix for Long Term risk:

Long Term Risk

	Mortality	Stop Loss	Rider	Morbidity	Longevity	Variable Annuity	Other
Mortality	100%						
Stop Loss	75%	100%					
Rider	75%	75%	100%				
Morbidity	25%	0%	0%	100%			
Longevity	-50%	-50%	-50%	0%	100%		
Variable Annuity	0%	0%	0%	0%	0%	100%	
Other	12.5%	25%	25%	25%	25%	25%	100%

Rider risk covers product rider risk not captured within Mortality, Morbidity, Longevity or Stop Loss categories
Variable Annuity risk from GMAB, GMIB, GMDB, GMWB, GEEB benefits
Other risk covers policyholder behavior and expense risks

Canadian LICAT

The aggregate capital requirement within a geographic region comprises requirements for each of five risk components: Credit risk, Market risk, Insurance risk, Segregated funds guarantee risk, Operational risk

There is 50% correlation between Insurance risk and the sum of Credit and Market risks in addition to nested correlation within the more granularly defined components of Insurance risk.

The Adjusted Diversified Requirement formula imposes a limit on the total amount of diversification credit.

	Credit & Market	Insurance
Credit & Market	100%	
Insurance	50%	100%

Source: https://www.osfi-bsif.gc.ca/en/guidance/guidance-library/life-insurance-capital-adequacy-test-2023-chapter-11-aggregation-diversification-risks

Canadian LICAT – Insurance Risk

The nested correlation between Insurance risks:

	Mortality	Longevity	Morbidity incidence & claims	Morbidity termination	Lapse sensitive	Lapse supported	Expense
Mortality	100%						
Longevity	-25%	100%					
Morbidity incidence & claims	50%	-25%	100%				
Morbidity termination	-25%	50%	25%	100%			
Lapse sensitive	25%	25%	50%	50%	100%		
Lapse supported	0%	-25%	0%	-25%	-50%	100%	
Expense	50%	25%	50%	50%	50%	-25%	100%

The further nested correlation between level and trend components of mortality risk for life and death supported business is -75%:

	Life supported	Death supported
Life supported	100%	
Death supported	-75%	100%

Source: https://www.osfi-bsif.gc.ca/en/guidance/guidance-library/life-insurance-capital-adequacy-test-2023-chapter-11-aggregation-diversification-risks