Canadian Institute of Actuaries | Institut canadien des actuaires

Explanatory Report

Development of the Ultimate Reinvestment Rates (URRs)

Committee on Life Insurance Financial Reporting

June 2018

Document 218091

Ce document est disponible en français

MEMORANDUM

To: All life insurance practitioners

From: Faisal Siddiqi, Chair
Practice Council

Stéphanie Fadous, Chair
Committee on Life Insurance Financial Reporting

Date: June 26, 2018

Subject: **CLIFR Subcommittee Explanatory Report – Development of the Ultimate Reinvestment Rates (URRs)**

The Committee on Life Insurance Financial Reporting (CLIFR) has prepared this CLIFR subcommittee report to provide supplementary information on the development of the ultimate reinvestment rates (URRs) promulgated by the Actuarial Standards Board (ASB) in July 2017.

This report provides information about the mandate and methodology applied by CLIFR's Subcommittee on Emerging Expectations of Future Reinvestment. As well, it includes commentary on some of the considerations and challenges in developing the ultimate reinvestment rates (URRs) in order to support actuaries who may be undertaking similar work.

CLIFR would like to acknowledge the contribution of its subcommittee that reviewed the URRs and provided a recommendation thereon to CLIFR and in turn the ASB. Members of the subcommittee were Jonathan Boivin, Steven Chen, Trudy Engel, Wes Foerster, Saul Gercowsky, Martin Labelle, Lisa Miolo, Jean-Philippe Morin, Caroline Rendall (Chair), and Jean-Yves Rioux.

In accordance with the Institute's Policy on Due Process for the Approval of Guidance Material other than Standards of Practice and Research Documents, this CLIFR subcommittee report has been prepared by CLIFR and has received approval for distribution from the Practice Council on May 15, 2018.

If you have any questions or comments regarding this CLIFR subcommittee report, please contact Stéphanie Fadous, Chair of CLIFR, at her CIA online directory address, Stephanie_Fadous@manulife.com.

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1 Introduction

Subsection 2330 of the Standards of Practice describes the prescribed interest rate scenarios to be used in the Canadian Asset Liability Method (CALM), and references ultimate risk-free reinvestment rates that are used in the construction of the base and prescribed scenarios. For Canadian insurance, these ultimate risk-free reinvestment rates (URRs) are promulgated from time to time by the Actuarial Standards Board (ASB), with the initial promulgation published in May 2014 and an update promulgated in July 2017. For other jurisdictions, the actuary is directed by paragraph 2330.13 to either consider historical relationships or, if necessary, determine independent scenarios.

The ASB asked the Committee on Life Insurance Financial Reporting (CLIFR) to update the analysis underlying the initial promulgation for Canadian business, and this paper documents the approach and findings of that review. This document is not guidance for actuaries. This document provides insights to actuaries into the derivation of the promulgated URRs.

The methodology and considerations described below are based on results from a stochastic interest rate model which was calibrated appropriately for use.

2 Definitions

CTE (Conditional Tail Expectation) X is the average of those values that are above the X^{th} percentile of the range of liability values produced by the entire set of modelled scenarios where valuation is performed using stochastic scenarios.

Reinvestment strategy refers to the investment approach expected to be taken by the company in the application of its investment policy at future points in time.

Steady state is the point in time beyond which the distribution of model-generated interest rates changes only negligibly, or the influence of the starting interest rate is minimal.

Ultimate risk-free reinvestment rate (URR) refers to a stable interest rate at a given term (or range of terms) which is assumed to apply to investment activity undertaken at a future point in time.

3 Mandate of the Review

In 2013, CLIFR undertook a comprehensive review of the CALM scenarios, including the determination of URRs. The mandate of the current exercise was to update the data and determine whether any changes are needed to the URRs, without reconsideration of the scenario definitions or revisiting any other aspect of the process. Because the exercise was conducted with only a few additional years of data added to a long historical sample, the expectation was that the methods and assumptions used in 2013 would still be valid. A stochastic model was used to generate preliminary URRs, as per the description in the promulgation. The work of the CLIFR Subcommittee on Emerging Expectation of Future Reinvestment was to replace the currently promulgated URRs with the new preliminary values in a set of CALM scenarios, and validate that the deterministic valuation thus produced fell within the CTE 60–80 range from a stochastic valuation of the same asset/liability model. If this

test was met, no further analysis would be required. If not, then the URRs would need to be adjusted so that the deterministic valuation fell within the specified range.

A key input to this work is the result of the work that was done to update the calibration criteria for Canadian stochastic interest rate models.

4 Key Steps in Determination of URRs

4.1 Calibration of Stochastic Interest Rate Models

Calibration criteria were based on the work CLIFR performed in 2016, through its calibration working group. For more information on the criteria, see Calibration of Stochastic Risk-Free Interest Rate Models for Use in CALM Valuation (document 217085).

4.2 Draft URRs

It is important to note that this exercise used least-constraining models to generate the URRs. Given that actuaries are permitted to use any valid stochastic model, appropriately calibrated, the subcommittee sought to avoid introducing unintended constraints by its choice of model. It tested a number of stochastic models. The least-constraining models were the Extended Cox-Ingersoll-Ross (CIR) model for the short-term rate and the CIR model for the long-term rate. The parameterization of these models was based on Parameter Set 3, outlined in the educational note supplement titled Calibration of Stochastic Risk-Free Interest Rate Models for Use in CALM Valuation (document 217085).

From the chosen calibrated interest rate models and parameters, 100,000 interest rate scenarios were generated.

From the resulting scenarios, the URR-low and URR-high (one-year and 20-year) rates were set to approximate the average of the lowest and highest 30 percent of the risk-free interest rates, respectively, in the stochastic projections 60 years from the start of the projection period. The following table looks at the draft interest rates from the stochastic analysis versus the promulgated URR-low and URR-high rates.

	Raw Rate	Promulgated Rate
Short-term URR-low	1.27%	1.3%
Short-term URR-high	9.57%	9.6%
Long-term URR-low	3.18%	3.2%
Long-term URR-high	9.99%	10.0%

The draft URR-median short-term and long-term rates were set equal to the median value (rounded to the nearest 10 basis points) of observed monthly historical one-year maturity and 20-year maturity par rates respectively, i.e., they were not derived from stochastic models. The historical time period was January 1936 to June 2016. The following table looks at the observed historical median interest rate versus the promulgated URR-low and URR-high rates.

	Historical Rate	Promulgated Rate
Short-term URR-median	3.97%	4.0%
Long-term URR-median	5.21%	5.2%

Given the current low interest rate environment and the exposure of insurance companies to long-term reinvestment risk, higher interest rate scenarios did not enter into the analysis, and thus testing was not completed on the recommended URR-high values. CLIFR intends to review this work annually. The testing approach may need to be altered if interest rates rise enough to consider additional analysis on the URR high. The remainder of the discussion in this document is focused on the URR low.

4.3 CALM Model

As part of the 2013 review, a model was created to represent a generic insurance company consisting of two asset segments, each with its own segmented assets, liabilities, and reinvestment strategies. One segment represented a pool of long-term life insurance liabilities, and the other segment included a pool of payout annuities; this focussed on the products most impacted by a long-term low interest-rate environment. Each included a reinvestment strategy designed to produce a reasonable relationship between the asset and liability cash flows. The cash flows were not interest sensitive. This model was reused for the current exercise given the mandate to avoid process change.

4.4 Creation of Valuation Interest Rate Scenarios

Starting from the current interest rate environment, represented for this exercise by September 30, 2016 risk-free yield curves, a set of 10,000 stochastic scenarios was generated using the calibrated interest rate model referenced above. Consideration was given to using the same 100,000 scenarios which underlay the process discussed in section 4.2, but the time to run the valuation models using that large a scenario set was prohibitive. A set of prescribed deterministic scenarios was produced from the same starting yield curves, following the standards of practice but replacing the URRs with the draft URR-low and URR-high values from the step described in 4.2 above.

4.5 Comparison of Stochastic and Deterministic Results

CALM valuations were performed using both stochastic and deterministic scenario sets, and the results compared to ensure that the worst prescribed deterministic scenario fell into the CTE70 to CTE80 range from the corresponding stochastic valuation results, ideally for each portfolio and in aggregate. Although the range for reserves is typically CTE60–80, it was felt that a deterministic result in the higher end of the range would be appropriate. Although the deterministic scenarios cover a range of possible outcomes they are limited in number; thus it is appropriate to have a deterministic result in the higher end of the range.

The primary focus of the subcommittee was the life liabilities, since the annuity results were far less sensitive to both changes in the URRs and current economics, and generally settled in the CTE85–CTE90 range as compared to stochastic reserves for that block.

Had the results not indicated the desired consistency between stochastic and deterministic valuations, the draft URRs would have been adjusted either up or down as required, and the CALM testing repeated.

4.6 Sensitivities

In light of upward movement in interest rates between the end of the data period in question (mid-year 2016) and Q1 2017, a sensitivity was produced to confirm that, if interest rates continued to trend slowly upward, the proposed URRs would still lead to a deterministic result that fell within the desired CTE range. An upward 1 percent parallel shift in December 31, 2016 rates was used as the starting risk-free yield curve for the valuation, and both stochastic and deterministic valuations were produced given the higher starting point. The CTE condition was still met.

5 Considerations/Challenges

The following are various considerations that emerged during the subcommittee's development work. They have been included so that other actuaries might benefit from these learnings.

5.1 Degree of Asset-Liability Matching in the CALM Model

It is important that the CALM model reflects only a reasonable degree of matching between assets and liabilities, and that the reinvestment strategy be realistic. If the matching was unreasonably strong, the dispersion of results would not have been sufficient to allow for a good comparison between stochastic and deterministic results.

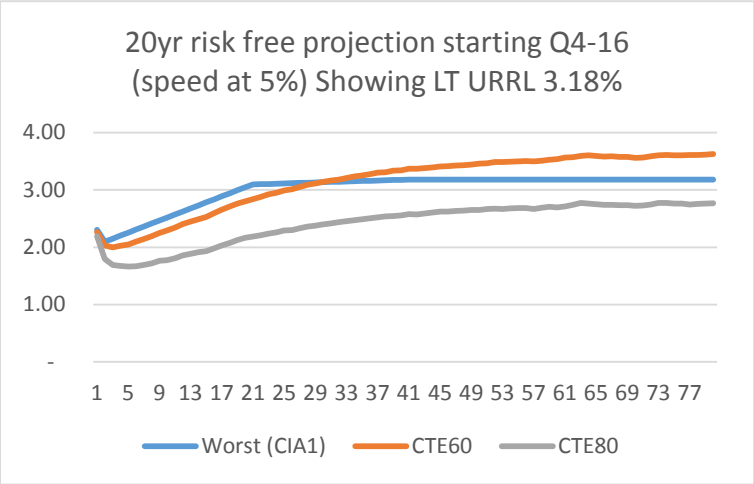
5.2 Speed of Mean Reversion in Stochastic Scenarios

The speed of mean reversion used in generation of the stochastic scenario set was a very significant parameter. A speed of 5 percent was used in the final analysis, which is consistent with the choice made in the 2013 exercise. This speed implies a reversion to a steady state in approximately 20 years. Use of a lower mean reversion speed during the development of the analysis led to stochastic scenarios which generally exhibited lower interest rates than prescribed scenario 1 (P1) from the Standards of Practice in the first 20–30 years; P1 was the worst deterministic CALM scenario. This resulted in the P1 liability falling as much as 15 percentage points lower in the CTE comparison to the new set of stochastic liabilities, leading to the conclusion that results are very sensitive to this parameter.

5.3 Analysis of Model Output

A useful tool for analysis in the exercise was to rank interest rates at all points in the future from the stochastic scenarios, and graph the rates at the desired CTE level for the long-term (20-year), low, risk-free interest rate against the pattern of rates for the same term from P1. Note that this is not the same as graphing the rates from the unique scenario that generated the liability at CTE60 or 80, as those rates would be expected to show a more irregular pattern. Graphing rates across the distribution of scenarios showed a view of the shape of the distribution of stochastic yield curves. When the stochastic scenarios were generated using a higher mean reversion speed, there was good alignment between the shape of the long-term

rate in P1 and the comparable rates from the stochastic scenario set. This was true for the 2013 exercise, and only slightly less true in the current analysis. A sample graph is shown below.



"LT URRL" in the title above refers to the long-term URR low. The x-axis is duration from the start of the projection, in years.

Given the grading pattern toward the URR for the CALM scenarios specified in the standards, it would be useful for the actuary to understand how this differs from the stochastic scenario set calibrated to match historic results for the jurisdiction in question. It is possible that the shape of the deterministic scenario is not consistent with the stochastic result. Although it is mathematically possible to calibrate the deterministic results to be within CTE60–80 of the stochastic results by adjusting the URRs up or down, it is clear that the pattern of any cash flow mismatches would become very important when layered onto a pattern with material gaps between the worst deterministic scenario (P1 or "CIA1" in the graph above) and the stochastic interest rate paths. Given this challenge, the actuary could consider running additional deterministic scenarios to better assess the risk.

Note that although this analysis was useful for P1, it is unclear whether it would be equally useful for other worst-prescribed scenarios.

6 Conclusion

Based on this work, the subcommittee recommended a long-term URR-low value of 3.2 percent, which fell within the desired CTE60–80 range of the stochastic results.