Canadian Institute of Actuaries / Institut canadien des actuaires

Educational Note

IFRS 17 Market Consistent Valuation of Financial Guarantees for Life and Health Insurance Contracts

Committee on Life Insurance Financial Reporting

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The actuary should be familiar with relevant educational notes. Educational notes are not binding; rather they are intended to illustrate the application of the standards of practice. A practice that an educational note describes for a situation is not necessarily the only accepted practice for that situation nor is it necessarily accepted practice for a different situation. Responsibility for ensuring that work is in accordance with accepted actuarial practice lies with the actuary. As accepted actuarial practice evolves, an educational note may no longer appropriately illustrate the application of standards. To assist the actuary, the CIA website contains a reference of pending changes to educational notes.

MEMORANDUM

To: Members in the life insurance area

From: Steven W. Easson, Chair
Actuarial Guidance Council

Steve Bocking, Chair and Marie-Andrée Boucher, Immediate Past Chair
Committee on Life Insurance Financial Reporting

Date: June 30, 2022

Subject: **Educational Note: IFRS 17 Market Consistent Valuation of Financial Guarantees for Life and Health Insurance Contracts**

The Committee on Life Insurance Financial Reporting (CLIFR) has prepared this educational note to provide guidance related to the completion of a market consistent valuation for insurance contracts with financial guarantees within the scope of the International Financial Reporting Standard (IFRS) 17.

The educational note is structured in five sections. Section 1 introduces the content presented in this educational note. Section 2 discusses the use of stochastic modelling with an emphasis on expected practices for the IFRS 17 valuation of insurance contracts with financial guarantees. Section 3 outlines how stochastic scenarios can be determined such that they replicate market observable prices, plus potential methodologies to estimate market prices when they are not observable. Section 4 discusses adjustments (e.g., liquidity adjustments, etc.) that may be made to reflect the differences between market instruments and the financial guarantees within insurance contracts. Section 5 outlines additional items with a specific focus on segregated funds.

This educational note is written primarily from the perspective of Canadian actuaries and is not intended to duplicate any other guidance. Further information ("guidance") can be found in International Actuarial Association (IAA) guidance and other Canadian Institute of Actuaries (CIA) documents

A preliminary version of the draft of this educational note was shared with the following committees prior to publication:

- Property & Casualty Insurance Financial Reporting Committee
- Committee on Risk Management and Capital Requirements
- Committee on the Appointed/Valuation Actuary
- International Insurance Accounting Committee
- Committee on Workers' Compensation

A preliminary version of the draft of this educational note was also shared with the staff of the Accounting Standards Board (AcSB) to broaden consultations with the accounting community.

Given that this educational note provides actuarial guidance rather than accounting guidance, the AcSB staff review was limited to citations of and any inconsistencies with IFRS 17. CIA educational notes do not go through the AcSB's due process and therefore, are not endorsed by the AcSB.

The draft of this educational note was also presented to the Actuarial Guidance Council (AGC) in the months preceding this request for approval. CLIFR satisfied itself that it had sufficiently addressed the comments received on the draft of this educational note and it was published May 2020.

The following highlights the changes between this educational note and the draft published version:

- Refreshed references to IFRS 17 materials published or edited since May 2020
- Other minor edits for increased clarity and grammar

Given that the changes made to the final version of this educational note relative to the draft published version were not substantial, the final version of this educational note was only subject to a limited review by the CIA committees.

The creation of this memorandum and educational note has followed the AGC's Protocol for the adoption of educational notes and other material. In accordance with the CIA's *Policy on Due Process for the Approval of Guidance Material other than Standards of Practice and Research Documents*, this educational note has been prepared by CLIFR and has received approval for distribution from the Actuarial Guidance Council on February 8, 2022.

The actuary should be familiar with relevant educational notes. Educational notes are not binding; rather they are intended to illustrate the application of the standards of practice. A practice that an educational note describes for a situation is not necessarily the only accepted practice for that situation nor is it necessarily accepted practice for a different situation. Responsibility for ensuring that work is in accordance with accepted actuarial practice lies with the actuary. As accepted actuarial practice evolves, an educational note may no longer appropriately illustrate the application of standards. To assist the actuary, the CIA website contains a reference of pending changes to educational notes.

CLIFR would like to acknowledge the contribution of its subcommittee that assisted in the development of this educational note: Dean Stamp (Chair), Robert Berendsen, Francis Bergeron, Benoît-Pierre Blais, Steve Bocking, François Boulé, Brian Fortune, Emmanuel Hamel, Sara Lang, Francis Laporte, Bruno Montminy, Jonathan Nadeau, and Alan Wong.

Questions or comments regarding this educational note may be directed to the Chair of CLIFR and this subcommittee (noted above) at guidance.feedback@cia-ica.ca.

SWE, SB, MAB

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1. Introduction

IFRS 17 establishes principles for the recognition, measurement, presentation, and disclosure of insurance contracts.

The concept of market consistency, and the use of market variables, is noted throughout the IFRS 17 guidance. Market variables used in the determination of fulfilment cash flows (FCF) should be consistent with observable market prices. The concept of market variables is described in IFRS 17.B42–B48, while IFRS 17.B74–B82 discuss the use of market variables to determine the discount rate.

This educational note provides practical application guidance on Canadian-specific issues relating to completing a market consistent valuation for insurance contracts that contain financial guarantees.

The sections that follow in this educational note provide more specific application guidance for Canadian actuaries, specifically for the market consistent valuation of insurance products with financial guarantees within the Canadian market.

In addition to the guidance above, this document will discuss different stochastic modelling approaches for market variables (e.g., equity returns, interest rates, etc.). It also discusses specific items related to segregated funds with guarantees, and other interest rate guarantee products.

The guiding principles that the CLIFR subcommittee followed in writing this note were the following:

- First and foremost, consider Canadian-specific perspectives, rather than simply repeating international actuarial guidance.
- Provide application guidance that is consistent with the IFRS 17 standard and applicable Canadian actuarial standards of practice and educational notes, without unnecessarily narrowing the policy choices available in the IFRS 17 standard.
- Consider practical implications associated with implementation of potential methods; in particular, ensure that due consideration is given to options that do not require undue cost and effort to implement.

Chapters 2 and 3 of the CIA educational note *Application of IFRS 17* Insurance Contracts provide general guidance on market variables. This educational note, published in October 2021, is an adoption of the International Actuarial Note (IAN) 100, which is accompanied by a preamble. The preamble outlines a number of additional clarifications on the topics discussed in the final version of the IAN 100 that CIA members should be aware of.

This educational note is structured as follows:

Section 2: Stochastic Modelling

- Stochastic modelling is expected to be a common practice to replicate market prices and then to measure financial guarantees within insurance contracts. This section discusses the use of stochastic modelling with an emphasis on expected practices for the IFRS 17 valuation of insurance contracts with financial guarantees.

Section 3: Market Consistent Valuation

- A starting point for the valuation of financial guarantees within insurance contracts is the determination of stochastic scenarios that replicate market observable prices. This section discusses this topic, plus potential methodologies to estimate market prices when they are not observable.

Section 4: Adjustments to Market Prices

- This section discusses adjustments (e.g., liquidity adjustments, etc.) that may be made to reflect the differences between market instruments and the financial guarantees within insurance contracts.

Section 5: Segregated Fund Specific Considerations

- This section discusses additional items with a specific focus on segregated funds. Although not uniquely applicable to a market consistent valuation (i.e., the focus of this note), the subcommittee felt it was beneficial to include a discussion of these topics.

At the end of the document, there is a Glossary of terms and an Additional Resources section. These are intended to provide simple definitions of some terms used within the document, plus references to academic literature related to stochastic modelling and market consistent valuation.

This educational note includes references to educational notes and other guidance that were developed prior to IFRS 17. A future review of pre-IFRS 17 guidance may lead to changes in these materials.

2. Stochastic modelling

According to IFRS 17.B46, “a replicating asset is one whose cash flows <u>exactly match</u>, in all scenarios, the contractual cash flows of a group of insurance contracts in amount, timing and uncertainty”. IFRS 17.B47–B48 notes that a replicating portfolio technique does not need to be used, and that other techniques such as stochastic modelling may be more robust and easier to implement. However, where replicating assets do exist for some cash flows, the entity would satisfy itself that the selected technique does not produce a result that is materially different than the result obtained from a replicating portfolio technique. Judgment is required to determine the technique that best meets the objective of consistency with observable market variables based on the specific facts and circumstances.

As financial guarantees within insurance contracts (e.g., segregated funds, minimum interest guarantees, etc.) often have complex guarantee features with dependencies on mortality and lapse rates, finding replicating assets that provide an exact match to the insurance contract cash flows may not be possible. Therefore, this educational note focuses instead on the use of stochastic modelling techniques. However, this does not exclude the possibility that other techniques, including a replicating portfolio technique, can be used to value financial guarantees within insurance contracts.

A stochastic model generally has two major components: 1) an economic scenario generator (ESG), and 2) a liability cash flow model. Economic scenario generators are discussed in Sections 2.1 through 2.5. Policyholder behaviour liability cash flow modelling is discussed in Section 2.6.

Further guidance on IFRS 17 liability cash flow models can be found in the educational note *IFRS 17 Estimates of Future Cash Flows for Life and Health Insurance Contracts*.

2.1 Economic scenario generators

An economic scenario generator (ESG) is a model that simulates possible future paths of economic and financial market variables (e.g., equity market returns, risk-free interest rates, credit spreads, inflation, etc.).

ESGs are commonly used by insurers in risk analysis and in the valuation of product features with significant optionality (i.e., that feature a significantly asymmetric distribution of outcomes around a median outcome). ESGs are often classified as being either "real-world" or "risk-neutral". In general, scenarios from real-world ESGs are used for measuring risk and for addressing "what if" scenarios to quantify the impact of possible future events (probability-weighted), while scenarios from risk-neutral ESGs are used for pricing cash flows for embedded derivatives. Real-world ESGs are calibrated to produce scenarios that mimic the distribution of actual historical returns or exhibit a user's own views about the distribution of potential future outcomes. Risk-neutral ESGs are calibrated to produce scenarios which, when used to calculate the price of options traded on the financial markets, reproduce the observable market prices of those options.

Practitioners typically use risk-neutral ESGs rather than real-world ESGs to perform market consistent valuations. However, with the use of deflators[1], real-world ESGs can also be made to be market consistent. For valuation under IFRS 17, both a market consistent risk-neutral ESG and a market consistent real-world ESG with deflators can be used.

2.2 Construction of an ESG model

The key requirement for an ESG model is that the model calibration 'fits' the target.

Regardless of whether a real-world or risk-neutral model is chosen, the IFRS 17 valuation must be market consistent. Martingale tests[2] would be performed to ensure the model is arbitrage-free which is a necessary condition with a market consistent valuation. General stochastic modelling considerations for risk-neutral models and real-world with deflator models are provided below in Sections 2.3 and 2.4, respectively.

Once a market consistent ESG model is calibrated to reproduce observable prices of traded market instruments, then, consistent with IFRS 17.B78(c), the same set of scenarios would be used to estimate the value of options/guarantees embedded in insurance contracts provided the insurance contracts have the same characteristics as the market instrument. In many cases, insurance contracts differ in at least one characteristic (in particular, liquidity) compared to available market instruments. In those cases, the ESG would be adjusted for differences between the embedded options/guarantees and the market instruments to which the ESG and scenarios are calibrated.

This calibration could involve a multi-step iterative process, for example:

1. Estimate ESG model parameters.

[1] See Glossary of Terms

[2] Sections 9.4 and 10.2 of the 2016 SOA Paper *Economic Scenario Generators, A Practical Guide* provide helpful details with respect to martingale tests; see also Glossary of Terms.

2. Generate scenarios and use them to calculate prices of traded options.
3. Compare calculated prices with observable market prices.
4. If calculated prices are not close enough to market prices, return to step 1 and adjust parameters.
5. The ESG would then be adjusted for differences between the embedded options/guarantees and the market instruments to which the scenarios are calibrated, if any.

The March 2002 CIA Report *CIA Task Force on Segregated Fund Investment Guarantees* and the 2016 SOA Paper *Economic Scenario Generators, A Practical Guide* are valuable references that have content on ESG models and modelling.

2.3 Risk-neutral models

A risk-neutral ESG and valuation framework is mostly concerned with mathematical relationships within and among financial instruments. When calibrated to produce prices for market instruments consistent with observable market prices (e.g., interest rate swaptions, equity index options, etc.), a risk-neutral framework is most commonly used by insurers to determine a market consistent value for a set of cash flows that depend non-linearly upon the outcome of financial market variables (typically interest rates and equity returns). Risk-neutral or market consistent ESGs would be updated at each valuation date to reflect the prevailing market conditions.

Further details on the form of stochastic interest rate and stochastic asset return models that could be used in various aspects of a risk-neutral valuation are provided below in Sections 2.3.1 and 2.3.2.

2.3.1 Stochastic interest rate models

There are three potential usages of stochastic interest rate models in a risk neutral valuation:

1) For discounting (see Section 2.3.1.1)
2) To value interest rate options (see Section 2.3.1.2)
3) As an input to the asset return projection model (see Section 2.3.1.3)

Note that when using an interest rate model for either of the last two purposes above, the same model must be used for discounting, in order to pass the martingale test under the risk-neutral probability measure. Examples of model forms for each purpose are given below.

2.3.1.1 Interest rate models for discounting

Interest rate models that generate arbitrage-free interest rates would be used to discount the market guarantees. Arbitrage free interest rate models include affine term structure models[3], Heath Jarrow Merton class (HJM), etc.

Among these arbitrage-free interest rate models, there are some models which can perfectly replicate the observable risk-free spot curves (e.g., HJM) and some models that cannot perfectly replicate the observable risk-free spot curve (e.g., Cox-Ingersoll-Ross). A model that perfectly

[3] See Glossary of Terms

replicates the observable risk-free spot curve would generally be favoured over a model that cannot.

2.3.1.2 Interest rate models for options on interest rates

An actuary could use a stochastic interest rate model to value options on interest rates. A model that permits the replication of observable prices for options on interest rates (swaptions, floors, caps, etc.) would be favoured over a model that cannot. The Libor Market Model (LMM)[4] could be used to replicate the prices of swaptions, floors and caps (e.g., see Brigo, D. & Mercurio, F. (2006)). The HJM could also be used to price swaptions (e.g., see Henrard (2003)). The same model would be used for discounting the option cash flows.

2.3.1.3 Interest rate models as inputs to asset return models

In its most general form, the short rate or money market rate from a stochastic interest rate model is used as the risk-free return component within an equity (and other) asset return model construct within a risk-neutral framework. Other yields from the same stochastic interest rate model, corresponding to the bond fund tenors being modeled, are also passed through to the bond fund return model when using a "first principles" approach. In order to ensure that asset return models in the risk-neutral probability measure pass the martingale test, the same interest rate model used to project asset returns must also be used for discounting (i.e., discounting is based on the modeled short rate or money market rate). A consequence of this is that scenario specific discount rates are needed when using asset return models that use stochastic interest rates as an input and deterministic discount rates are needed when using asset return asset return models that use deterministic interest rates as an input.

Section 2.3.2 covers model choices for asset returns in more detail.

2.3.2 Asset return models

2.3.2.1 Bond fund return models

In the most general model form, stochastic bond fund returns would be based on stochastic risk-neutral interest rate projections converted into bond fund returns.

Stochastic interest rate scenarios can be used to directly model changes in bond fund market values and future yields. This type of "first principles" bond fund return calibration would require all the assumptions needed for calibrating the stochastic interest rate model, as well as market consistent assumptions for bond fund duration, credit spreads, interest rate/credit spread correlations, defaults, etc., some of which may not be readily available and require judgment.

Alternatively, simpler approaches still employing stochastic interest rates may also be acceptable, such as using an equity (and other) asset return construct to model bond fund returns, especially where assumptions needed for the "first principles" approach require significant areas of judgment.

It should also be noted that the use of stochastic interest rate models may not be necessary in all cases. The actuary could consider simpler approaches such as using a deterministic interest rate with an equity (and other) asset return model to stochastically model bond fund returns, where such simplifications provide a result within a reasonable level of approximation. Items to

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[4] See Glossary of Terms

consider when determining a reasonable level of approximation could include the materiality of the bond funds' risk in the context of the overall risk of the embedded option being valued and the availability of relevant market information.

The interest rate model choice for bond fund returns would be the same as the one chosen for discounting.

2.3.2.2 Equity (and other) asset return models

In its most general form, equity (and other) asset return models use a risk-neutral measure based on the same interest rate scenarios used to derive bond fund returns. Specifically, if stochastic interest rates were used to model bond fund returns, then the same stochastic interest rates would need to be used to model equity (and other) asset returns. Similarly, if deterministic interest rates were used to model bond fund returns, then the same deterministic interest rates must be used model equity (and other) asset returns.

In order to ensure that asset return models in the risk-neutral probability measure pass the martingale test, the interest rate model used to model asset returns must also be used for discounting. As valuation cash flows are generated from both equity (and other) asset returns and bond fund asset returns, this condition can only be met if the same interest rate model is used for all asset return models.

A model that permits the replication of observable prices for options on equity returns (options, etc.) would be favoured over a model that cannot. There are many approaches to model equity returns, such as a log normal approach (e.g., Black-Scholes model), a regime-switching log normal approach, or a stochastic volatility approach.

2.4 Real world models with deflators

A real-world ESG and valuation framework is concerned with producing a realistic distribution of potential future paths of economic variables, and it is commonly used in risk management practice when distribution of outcomes is the focus. Real-world scenarios are typically calibrated to historical benchmarks, and may also reflect forward-looking views (i.e., expert judgment).

Both a real-world with deflator (RWD) approach and a risk-neutral approach should produce calculated prices that are consistent with observable market prices. The deflator can be defined as a stochastic discount rate under the physical probability measure P. This stochastic discount rate cannot take any form. The form of the deflator must be such that all accessible assets in a market are martingales and the market must be arbitrage-free.

The parameters of the deflator can be calibrated using the link between the deflators and the risk-neutral valuation, which is the Radon-Nikodym derivative[5]. More precisely, one can calibrate the parameters of the risk neutral probability measure Q and obtain the deflator as a product of a risk-neutral discount factor and the Radon-Nikodym derivative. This approach ensures consistency between risk-neutral valuation and the RWD approach.

For more details about deflators, the July 2014 *SOA Risk and Rewards Newsletter* article on Deflators or see Wüthrich (2016).

[5] See Glossary of Terms

2.5 Potential approximations and simplifications to stochastic modelling

The calculations described in this section can be computationally demanding and time consuming to complete. This section contains a non-exhaustive list of approximations and modelling techniques that could be used to reduce the number of required calculations.

It should be noted however that the use of the approximations and techniques discussed in this section may be constrained by other IFRS 17 reporting requirements. For example, IFRS 17 level of aggregation requirements, cohort reporting etc., may limit the use of compression techniques.

2.5.1 Reduce the number of scenarios used

The number of scenarios used in Monte Carlo simulations[6] is a driver for the computing time needed to complete the calculations. Techniques can be used to reduce the number of scenarios required to be processed for each contract while still maintaining a reliable result. However, the main drawback of these techniques is that the results in aggregate can be precise, but caution should be taken when looking at groups of insurance contracts.

The following are some potential ways to reduce the number of scenarios used:

1) ***Use different scenarios for each contract***

   This technique consists in using different scenarios for each contract that needs to be valued (e.g., applying scenario set x to contract 1, scenario set y to contract 2, etc.), where the scenario sets are generated using the same model and parameters. This application reduces the total number of scenarios run across all contracts since a smaller set of scenarios per contract can converge to the same result as using a large number of scenarios across all contracts. This technique is only possible with risk-neutral models since only the mean over all the scenarios is needed (i.e., CTE 0), and the technique cannot be used when the distribution of the aggregate results is needed to look at risk metrics (e.g., CTE 75, CTE 95, etc.)[7], or if the scenarios are not equally weighted (as with real-world with deflator models). A practical way to implement this technique would be to use the contract number as a seed for the random number generator. A variation on this technique is to also vary the number of scenarios used for each contract (e.g., using a greater number of scenarios for larger contracts and vice-versa, biasing the run time in favour of contracts that have the largest impact on the result).

2) ***Use variance reduction techniques***

   Variance reduction techniques allow a smaller number of scenarios to be used without material loss of precision in the results. Common techniques commonly used include but are not limited to (i) antithetic variates; this involves using scenarios in pairs; for example, if the uniform number u is used for one random path, another path would use 1-u; (ii) a control variate, (iii) importance sampling; and (iv) stratified sampling[8].

[6] See Glossary of Terms.

[7] The CTE(75) of contract A plus CTE(75) of contract B will not equal the CTE(75) of contract A and B combined, even if the same distribution is used. The CTE(0) of contract A plus CTE(0) of contract B should equal the CTE(0) of contract A and B, if the same distribution is used.

[8] See Glossary of Terms

2.5.2 Reduce the number of in-force records to process

Another method that can be used to reduce the computation time is to reduce the number of liability records that need to be processed. A way this can be achieved is by "compressing" the in-force. This means using techniques to do the same calculations on an in-force with a significantly lower number of contracts but obtain a similar result. There are multiple levels of complexity that can be used for compression algorithms depending on the needs of the actuary. There are simple methods like grouping similar contracts together based on in-force information to more complex methods like clustering.

If the compression algorithm is not aligned with the groups used for IFRS 17 reporting, an allocation method might be needed to allocate the total liability between the appropriate groups.

2.5.3 Reduce the frequency of the cash flows

The frequency of the modeled cash flows (monthly, quarterly, etc.) is a driver for the time needed to complete the calculations. If the impact of using monthly vs. quarterly cash flows is not material, then a quarterly valuation could be reasonable. Another way could be to use monthly cash flows for the first X years, quarterly cash flows for the next Y years and annual cash flows for the remaining.

2.5.4 Reduce the projection period

The projection period is a driver for the time needed to complete the calculations. If the impact of decreasing the projection period is not material, then a shorter period could be reasonable. Another option could be to use a shorter period and measure the remaining benefits with an annuitization formula.

2.6 Policyholder behaviour

A full discussion of policyholder behaviour is outside the scope of this educational note. There may be a correlation between the market variables and non-market variables (e.g., policyholder behaviour, etc.). If this is observed, the actuary would consider whether this should be reflected in the valuation. Policyholder behavior assumptions (e.g., lapse, partial withdrawals, other benefit utilization such as conversion and annuitization options) that have been deemed to vary with market variables would not need to be changed when moving between a real-world valuation framework and a market consistent risk-neutral framework as policyholders will not change their behaviour based on the adoption of IFRS 17. For additional information on this subject, see Panneton and Boudreault (2011) [3].

However, there may be specific situations where the calibration of the interaction between market variables and non-market variables (e.g., lapses) may need to be adjusted, consistent with IFRS 17.B53 which states, *"... in other cases, market variables and non-market variables may be correlated ... The entity shall ensure that the probabilities for the scenarios and the risk adjustments for the non-financial risk that relates to the market variables are consistent with the observed market prices that depend on those market variables*." An example of this is where the value of the guarantee is modeled as a present value of payments (e.g., PV of guarantee benefit payments on a GMWB product). In this example, the value of the guarantee may be impacted by moving from a real-world to risk-neutral discount rate, which in turn may require the dynamic lapse formula using this function to be recalibrated.

Finally, it should be noted that when including financial risk in the present value of cash flows, the non-financial risk assumptions (e.g., lapse rates) would be on a best estimate basis. If including a margin on the non-financial risk assumptions has a further impact of changing the cost of embedded options, then the impact of that change would be included in the risk adjustment for non-financial risk (rather than as part of the provision for financial risk in the present value of future cash flows).

3. Market consistent valuation

A market consistent value of an asset or liability is its market price, if it is readily traded on a market at the point in time that the valuation is struck, and, for any other asset or liability, a reasoned best estimate of what its market price would have been had it been readily traded at the relevant valuation point (Kemp 2009). This section aims to provide background and guidance on a market consistent valuation in Canada for insurance products with financial guarantees and discusses key items that would be considered in determining the cost of financial guarantees (e.g., equity returns, risk-free interest rates, currency, inflation, and correlations).

3.1 Background

In determining the "Estimates for future cash flows", IFRS 17.33(b) states that estimates shall "reflect the perspective of the entity, provided that the estimates of any relevant market variables are consistent with observable market prices for those variables" (underlining added). This is expanded upon in IFRS 17.B42–B53.

IFRS 17.B44 states that "Estimates of market variables shall be consistent with observable market prices at the measurement date. An entity shall maximise the use of observable inputs and shall not substitute its own estimates for observable market data except as described in paragraph 79 of IFRS 13 Fair Value Measurement. Consistent with IFRS 13, if variables need to be derived (for example, because no observable market variables exist) they shall be as consistent as possible with observable market variables."

There are three levels of inputs noted within IFRS 13 Fair Value Measurement:

Level 1 Inputs:

- Level 1 inputs are quoted prices (unadjusted) in active markets for identical assets or liabilities that the entity can access at the measurement date

Level 2 Inputs

- Level 2 inputs are inputs other than quoted prices included within Level 1 that are observable for the asset or liability, either directly or indirectly

Level 3 Inputs

- Level 3 inputs are unobservable inputs for the asset or liability

The prices for financial guarantees within insurance contracts in Canada cannot be directly observable within the market but some inputs to determine those prices are observable. For example, discount rates and market implied volatility can be determined based on option market prices (e.g., given a known option price and assuming a lognormal model, one can solve for an appropriate volatility – the "implied volatility" – to reproduce that price). Since they are not directly quoted prices, the discount rates and implied volatilities would be classified as Level 2 inputs. However, financial guarantees often have a longer duration than options and bonds available on the market which means that Level 3 inputs would be needed for the non-observable portion of the market. Within a Level 3 estimate, IFRS 13.89 states:

> An entity shall develop unobservable inputs using the best information available in the circumstances, which might include the entity's own data. In developing unobservable inputs, an entity may begin with its own data, but it shall adjust those data if reasonably available information indicates that other market participants would use different data or there is something particular to the entity that is not available to other market participants (eg an entity-specific synergy). An entity need not undertake exhaustive efforts to obtain information about market participant assumptions. However, an entity shall take into account all information about market participant assumptions that is reasonably available. Unobservable inputs developed in the manner described above are considered market participant assumptions and meet the objective of a fair value measurement.

As such, in addition to the use of an entity's own data, market prices for financial guarantees that are similar to those within insurance products in Canada would be considered.

The exact methodology used to complete a market consistent valuation is not prescribed under IFRS 17. IFRS 17.B48 states that "... Judgement is required to determine the technique that best meets the objective of consistency with observable market variables in specific circumstances. In particular, the technique must result in the measurement of options and guarantees included in the insurance contacts being consistent with observable market values (in any) for such options and guarantees."

Actuarial judgment would therefore be required to establish market consistent assumptions under IFRS 17 where market observable data does not exist, but also under certain circumstances, where it does exist. Examples of this are:

- Calibrating models across multiple data points. For example, since it is generally difficult to calibrate a stochastic interest rate model such that market observable values are reproduced across the full volatility surface, the model would instead be calibrated to reproduce market observable values at key tenors/maturities, and to 'reasonably reproduce' market observable values at other tenor/maturities, where the latter requires actuarial judgment regarding an appropriate calibration threshold.
- In Appendix A: Defined Terms of IFRS 13, *active markets* are defined as "A market in which transactions for the asset or liability take place with sufficient frequency and volume to provide pricing information on an ongoing basis". The classification of prices within large and orderly markets as coming from *active markets* may be straightforward; however, the classification of prices within smaller markets and/or less orderly markets (stressed) markets as *active markets* may be less obvious and requires judgment.

While models would initially be calibrated to reproduce market observable values, adjustments to these models would also need to be considered in respect of differences between the embedded options/guarantees and the market instruments to which the models were originally calibrated. These adjustments are discussed below and in Section 4 of this educational note.

It is expected that the market consistent risk-neutral models will be more widely used than real-world models with deflators, and as a result the following sections focus on market consistent risk-neutral models.

The IFRS 17 market consistent valuation model would be developed by first calibrating a market consistent risk-neutral ESG that will reproduce the observable market prices of financial instruments traded in an active market (e.g., swaps, swaptions, equity options, etc.).

This model would then be updated to reflect differences between the embedded options/guarantees and the market instruments, including:

1. Adjustments in respect of cash flows that do not vary with the underlying to reflect their liquidity characteristics as noted in IFRS 17.B79.
2. Adjustments in respect of contract features that are not reflected in the market instruments.

The liquidity adjustment would be reflected both in (i) setting the expected returns in the ESG that will generate returns used to project the liability cash flows; and in (ii) the discount rate used to discount liability cash flows back to the valuation date. This ensures that the equivalent martingale measure and market consistent arbitrage-free properties of the valuation are preserved. The liquidity adjustment is discussed in Section 5.3 of this educational note, as well as in the educational note *IFRS 17 Discount Rates for Life and Health Insurance Contracts*.

As noted in Section 2.3.2, the general form of a market consistent risk-neutral model requires assumptions regarding interest rates and volatility. Market consistent interest rates are discussed in the educational note *IFRS 17 Discount Rates for Life and Health Insurance Contracts*. Market consistent volatility assumptions are discussed in Section 3.3 below.

3.2 Market consistent interest rates

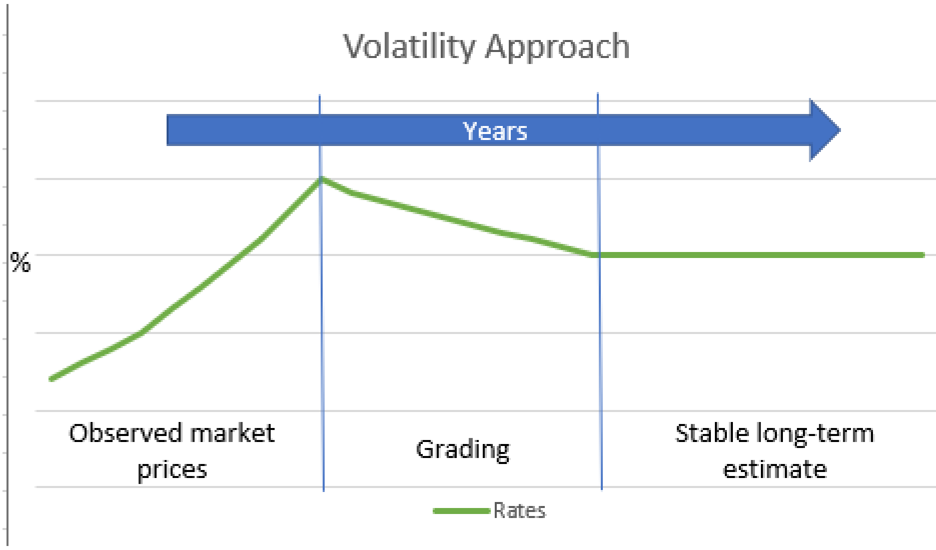
In a risk-neutral ESG, the expected return on assets would be equal to the risk-free interest rates. Liability cash flows generated using this model would be discounted at the same risk-free rates. Risk-free interest rates under IFRS 17 are discussed in the educational note *IFRS 17 Discount Rates for Life and Health Insurance Contracts*.

Regardless of the interest rate model chosen, the input yield(s) should be consistent with the market observable yield curve at the reporting date.

3.3 Market consistent volatility

As noted in the general market consistent considerations at the start of this section, the market consistent input needs to reflect market prices where they are observable and be consistent with hypothetical market prices where they are not observable. Considerations for adjusting market prices where they are not observable, including reflecting differences between the embedded options/guarantees within insurance contracts and the market instruments that are available to derive the market consistent volatility inputs are discussed in Section 4.

The general form of the IFRS 17 market consistent input measure is recommended as follows (with hypothetical/illustrated values for volatility input):



This methodology would apply in situations where there is an observable market. In some situations, there may not be an observable market and a long-term stable estimate may be the best and only input.

Market consistent volatility assumptions for equity returns, interest rate, and bond fund returns are considered in the following sections.

3.3.1 Equity volatility – Observable period

The main source of market prices for equity volatility would be equity options. Prices for equity options can be quoted by various market data providers. In addition to the price, the implied volatility may be quoted. These quotes translate the market price into an implied volatility using a Black-Scholes methodology (i.e., assume a lognormal model). This method requires only two inputs to determine the price for an option: the risk-free return and the volatility. Therefore, if the price is known, then the "implied" volatility can be solved for.

The implied volatility surface can be derived using prevailing call/put option prices. Volatility is available by in-the-moneyness (ITM) and tenor/term. Some volatilities are derived from observable prices (or interpolated between observable values) and some are extrapolated (unobserved) values.

Market information suggests that active market quotes are generally available for only three months for the TSX 60 (the main Canadian market) and for up to two years for the S&P 500[9] (the main US market). Quotes for longer terms may be available over-the-counter (OTC) from investment banks. These quotes are based on competitive bids from investment banks but might be less robust the farther out into the future they are. In practice, longer duration OTC quotes are rarely transacted upon, and as a result would not meet a Level 2 definition. Nevertheless, the OTC quotes may be the only direct reference for longer term implied volatility estimates and could be used to guide the actuary in developing a Level 3 estimate.

This highlights that it is likely only possible to get a Level 2 estimate in the very short-term for a specific index. OTC quotes, or information from other indices, could be used to extend the period from which market data are used, but adjustments would have to be made to any inputs

[9] Implied volatility index (VIX) is only available for up to 1 year, but active market quotes may be available for longer.

derived from that market information to reflect the low volume of trade and/or differences between the indices. The challenge would be in making reasonable adjustments to these values as the information required might not always be reasonable or supportable.

Another adjustment that could be considered is to apply information from the longer observable period for the S&P 500 to 'extend' the TSX 60 observable period data (e.g., extrapolate the (shorter) TSX observable market data using the (longer) observed grading on S&P 500 equity volatility).

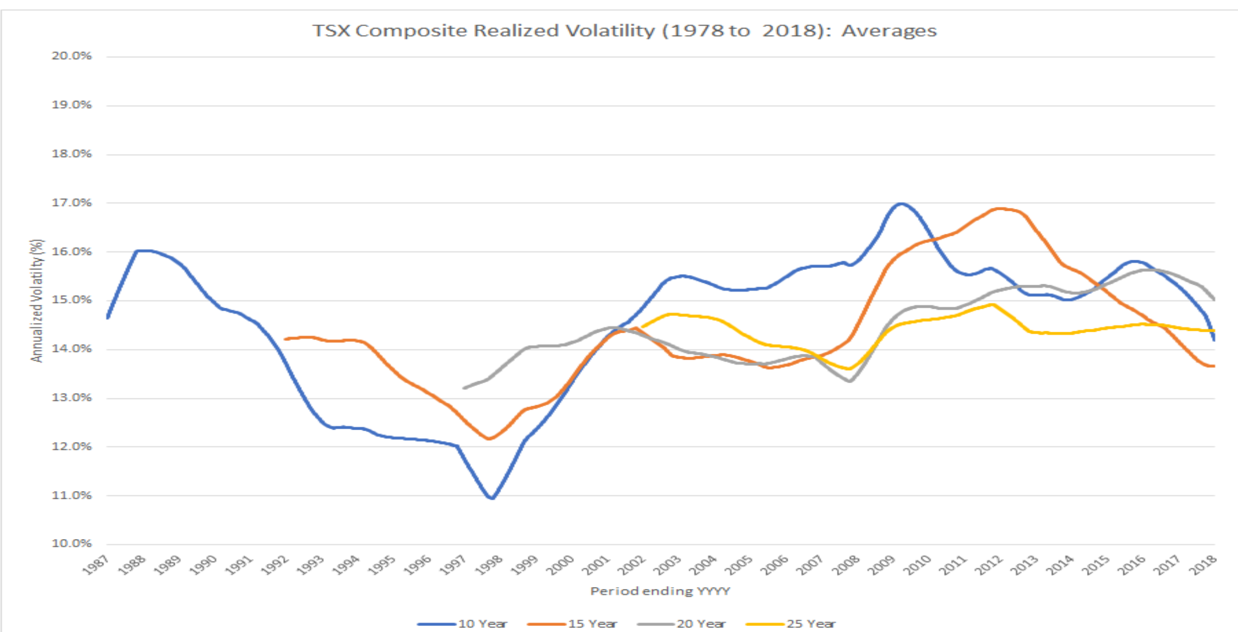
A summary of typical market observable data periods noted by the subcommittee is provided below.

Index	Observable Period
TSX 60	3-6 months
S&P 500	1.5-2 years
EAFE	1-1.5 year

3.3.2 Equity volatility – Ultimate (long-term) assumption

Given the lack of historical long-term implied volatility data (on indices other than the S&P 500), a starting point for the ultimate volatility assumption may be the observed long-term realized volatility.

The data period used to derive the long-term volatility assumption is an area of judgment. Shorter data periods ensure that the long-term assumption is more reflective of recent, but potentially volatile, market experience, whereas longer data periods ensure that the long-term assumption is averaged over more, but potentially less credible, market cycles. The following graph shows annualized monthly volatility calculated over different historical average data periods of 10, 15, 20 and 25 years:



Based on this data[10], the subcommittee observed that annualized monthly volatility calculated over a 20-year historical average data period, produces a reasonably stable long-term assumption.

While there is no definitive relationship between long-term implied volatility and realized volatility, it would be expected that over time implied volatility would generally be higher than realized volatility. For example:

- Implied volatility would reflect market pricing in respect of transaction costs, commissions, hedge errors, cost of capital, etc. that are not directly captured in the Black-Scholes equity option pricing model
- Implied volatility would reflect a term premium
- Implied volatility would reflect a volatility skew

The volatility skew differences noted above could be subject to differences in supply and demand, and as a result, the actuary would need to apply judgment in terms of how to reflect these in valuation of long-term liabilities.

Overall, while acknowledging that this is an area of judgment, the subcommittee considers that an adjustment of at least 20%[11] would be reasonable in respect of recognizing differences between realized and implied volatility.

An example of how the actuary could establish the ultimate long-term equity volatility assumptions is shown below. A similar process would be applied in respect of other major market indices.

Index	20-year historical average annualized monthly realized volatility	Realized volatility adjustment factor	Market consistent ultimate long-term implied volatility
TSX Composite	15.0%	20%	18.0%

3.3.3 Equity volatility – Transition period

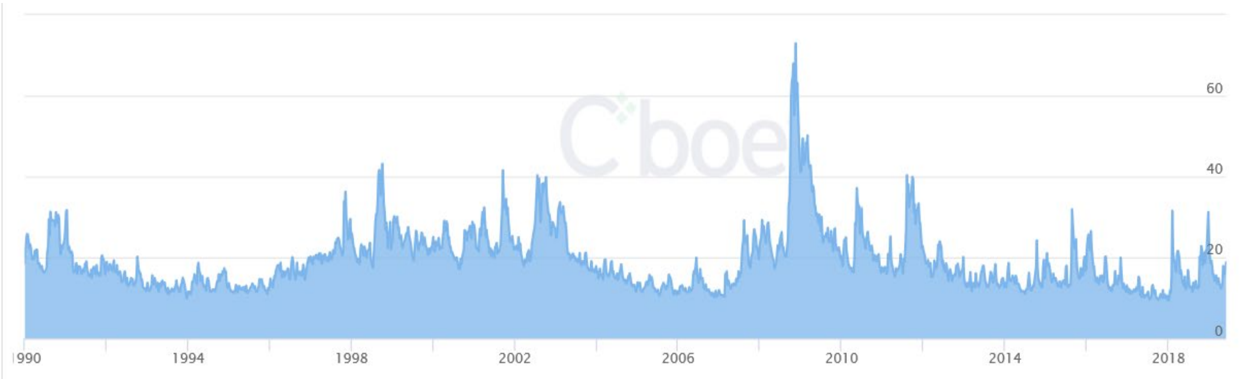
As shown in the following graphs, periods of high (or low) volatility are generally short-lived (i.e., the transition period from current observable market data to an ultimate long-term volatility is relatively quick).

The following graph shows historical data in respect of the VIX[12]:

[10] The data period 1978 to 2018 was used to have a reasonable amount of data in order to compare the changes in the rolling 10, 15, 20, and 25-year averages. These are rolling averages (e.g., 20-year results are Jan 1978 to Dec 1997, Feb 1978 to Jan 1998, etc.).

[11] Based on a high-level analysis of S&P 500 market return historical realized and implied volatility across a limited number of available tenors and maturity horizons.

[12] The VIX (or CBOE Volatility Index) is a common measure of the stock market's expectation of volatility implied by S&P 500 index options with an average expiration of 30 days (link to chart: http://www.cboe.com/products/vix-index-volatility/vix-options-and-futures/vix-price-charts). The VXEFA and VIXC are similar indices related to the short-term volatility expectation of the EAFE and S&P/TSX indices, respectively.

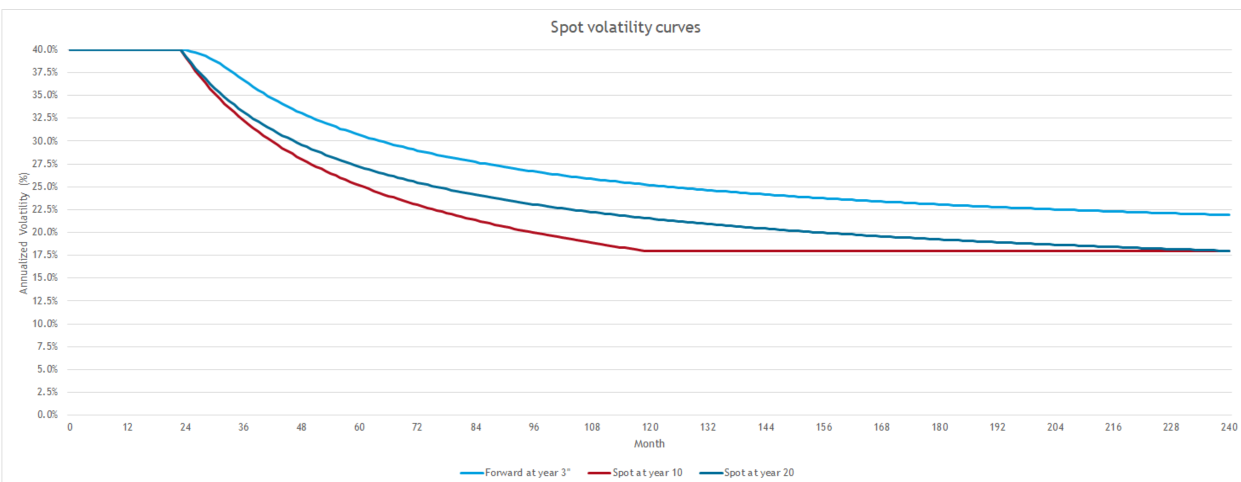


While it is clear the transition period between the end of the observable period and the ultimate long-term volatility would be relatively short, there is little market information beyond the observable period to provide guidance on the form of the transition.

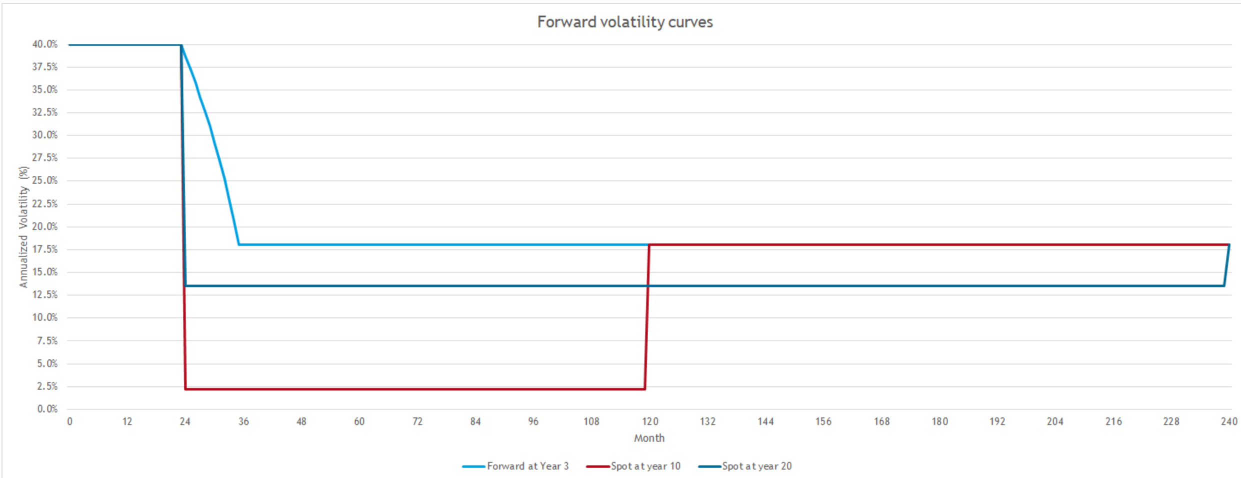
For example, transition to the ultimate volatility could be based on an interpolation[13] of either the forward variances (or volatilities) or spot variances (or volatilities). Both approaches are equally acceptable, and in general there is no market practice to indicate that one approach would be used in preference to the other.

It would be noted however that dependent on current market conditions, the use of ultimate spot rates could create implied forward rates that are lower than historically observed short-term implied volatilities. While formulaically correct, the actuary would need to consider if this is a reasonable representation of future market expectations.

The following graphs illustrate this issue. These graphs assume a high initial volatility environment of 40% and an ultimate volatility assumption of 18%:



[13] For example, linear interpolation, cubic spline, constant forward, Smith-Wilson, etc.



When starting from a high initial volatility environment, these graphs show that a transition to an ultimate volatility at year 3 based on forward rates, produces reasonably intuitive spot and forward rate curves. Similarly, a transition to an ultimate volatility assumption at year 20 based on spot rates, produces reasonably intuitive spot and forward rate curves in most situations.

Of note, however, a shorter spot rate transition period (at year 10 in this example), results in forward rates that could be considered too low relative to observed historical data. A more extreme example with higher initial volatility would result in negative forward rates.

The ultimate period starting at year 3 based on forward rates and starting at year 20 for spot rates are shown here for illustration but are considered by the subcommittee to be generally representative of appropriate equity volatility transition periods.

3.3.4 Risk-free interest rates volatility

The average result produced by a stochastic interest rate model, prior to any adjustment, would be consistent with the input risk-free interest rate curve (i.e., the interest rate curve at the reporting date). The observable and unobservable market for risk-free interest rates would consider the guidance provided in the educational note *IFRS 17 Discount Rate for Life and Health Insurance Contracts*.

The main options that could be used to determine the market observable implied volatility for risk-free interest rates are swaptions or interest rate caps/floors. The implied volatility produced for these different options may be different due to the models that are used to derive the interest rate volatility. This means that the actuary may have to use judgment with respect to which market prices to replicate. Interest rate floors may be the most applicable option in the market to replicate since they are similar to a minimum interest rate guarantee. This would be balanced by the fact that the market observable information for interest rate floors is less prevalent than interest swaptions.

Swaptions are usually available for specific tenors (or terms) and expiry dates. Swaptions on short tenors may be available with expirations up to 10 to 15 years, whereas longer term tenors would usually only be available for relatively short expirations up to one to two years. For example, a swaption on a one-year interest rate term may be available where this option expires in 10 to 15 years, whereas a swaption on a 20-year interest rate term may only be available where this option expires in one to two years.

It may not therefore be necessary to calibrate a market consistent “swaption price” across the full range of tenors/expirations, and instead the actuary could focus on the tenors/expirations that are the most relevant for the liabilities being valued.

Similar considerations regarding the risk-free volatility transition period and ultimate rates apply to those discussed above in respect of equity volatility. For example, a starting point for the ultimate implied interest rate volatility assumption could be the observed historical long term realized volatility of swap rates, where:

- Similar considerations regarding the appropriate data period apply to those discussed in Section 3.3.2. In addition, since inflation targets were first set in Canada in 1992, the use of historical data subsequent to 1992 is recommended for this purpose.

Unlike equity volatility, there is no clear relationship between interest rate implied and realized volatility. Of note, there are several data periods where interest rate implied volatility has been lower than realized volatility.

3.3.5 Bond fund return volatility

Two methodologies could be used:

1) A similar approach to equity returns modelling but replacing equity volatility with bond volatility.
2) Derive stochastic bond fund returns from the interest rates produced by an interest rate model (see Section 2.3.1), together with an assumed bond fund duration and possibly a stochastic model for credit spreads/losses.

Method 2) could be considered as being more theoretically correct and ensuring consistency between interest rates and bond values, but in practice the high-level nature of the bond fund duration and credit spread assumptions may limit the value of this approach. In theory, credit spreads and asset defaults/downgrades would be modelled stochastically independent from interest rates and have zero drift in order for the resulting bond fund returns to be risk-neutral. In practice, an explicit stochastic approach to credit spreads and asset defaults/downgrades may be approximated by assuming a higher interest rate volatility (relative to the risk-free interest rate volatility).

Method 1) would therefore likely be more practical and in most circumstances be considered reasonable when considering materiality of the bond funds’ risk in the context of the overall risk of the embedded option being valued and the quantity of assumptions needed in Method 2). Considerations for this method are discussed below.

Where market data is not observable, then consistent with the development of the equity volatility curve described in Section 3.3, the actuary could use a flat forward bond fund volatility assumption, based on long-term realized volatility with an adjustment to reflect the potential difference between implied volatility and realized volatility.

3.3.6 Market consistent volatility – Other asset classes

Volatility assumptions in respect of other assets classes (e.g., private equity, infrastructure, etc.) would be derived similarly to equity and bond fund volatility discussed in the previous sections. Of note, however, is that market observable data for these asset classes may not be available, or could be very limited, in which case the actuary could assume a flat volatility assumption based on long-term realized volatility with an adjustment to reflect the potential difference between implied volatility and realized volatility.

3.3.7 Market consistent volatility – Other considerations

The volatility assumptions discussed in the previous sections apply to funds that generally track well to the market indices for which the implied volatility was derived.

However, the economic scenarios are typically also used in combination to simulate the returns for managed funds (e.g., balanced funds, sector funds, actively managed funds, low volatility funds, global funds, etc.). For such funds, a common practice is to represent each managed fund as a linear combination of market indices (often obtained via linear regression of historical returns), such that the simulated returns for each managed fund are equal to a linear combination of the simulated market index returns (i.e., blended returns). The actuary would consider whether the resulting volatility of the blended returns used for a managed fund are appropriate given the characteristics of the fund.

If the volatility of the blended simulated returns for the managed funds are too low or too high, then a further adjustment would be made. Adjustments could be made using one or more of the following approaches:

- Adjust the long-term volatilities of the underlying market indices. This could be difficult as the market indices are often used to model several managed funds and it may not be possible to determine an adjustment that is suitable for each managed fund.
- Adjust the weights in the linear regression in such a way as to obtain an appropriate volatility for the managed fund, without materially deteriorating the appropriateness of its correlation with other funds.
- Add another return component to the linear combination of market indices, one which is specific to a given managed fund, has zero expected return, appropriate correlation with the fund’s market indices, and a magnitude of volatility such that the impact of this additional component on the managed fund’s simulated returns produces an appropriate total volatility.

Whether or not the market risk inherent in a given managed fund can be hedged is not directly relevant for the IFRS 17 valuation. Accordingly, basis risk is not directly relevant to the valuation. If it can be hedged (if there is no/little basis risk), then the relevant market instruments can be used more directly to help determine a market consistent valuation. If it cannot be hedged, then market instruments with similar features and similar volatility as the managed fund can still be used to help determine a market consistent valuation.

3.4 Other market consistent assumptions

3.4.1 Currency

When liabilities are a function of more than one currency, actuaries would use market consistent currency exchange rates for the valuation of the liabilities. A good example is a segregated fund product that specifies guaranteed benefits in Canadian dollars, but where at least some of the underlying asset return is linked to a US dollar equity index return such as of the S&P 500.

Different approaches to reflecting currency exchanges rates in a market consistent valuation are possible, and one such approach is described below. However, other methods may be possible. The actuary could consider applying other approaches where these provide a result within an acceptable degree of precision. For example, cash flow streams in different currencies without material non-linearity could be discounted using currency-specific discount curves and then translated to the functional currency at current exchange rates.

Actuaries would consider the following two dimensions with respect to currency exchange rates under the market consistent valuation framework:

1. Expected currency exchange rate
2. Volatility of the currency exchange rate

For each dimension, actuaries may be able to observe market consistent inputs for the shorter term and could extrapolate to derive longer-term assumptions.

In deriving market consistent expected currency exchange rates, for key foreign currencies, actuaries could use directly observable traded currency forward prices for the shorter projection period. Over longer-term or for some foreign currencies, however, there may not be any active market currency forward market. In this case, actuaries could apply interest rate parity[14] to derive an ultimate currency exchange rate. Though empirical evidence for this theory is unconvincing, IMF Staff Papers[15] cited that "over longer horizons, …, our results suggest that uncovered interest parity may significantly outperform naïve alternatives such as the random walk hypothesis…". The concept of interest rate parity could also be applied to model expected currency exchange rates in the ultimate period where ultimate interest rates for each currency/jurisdiction are also determined using judgment. For example, if the Canadian dollar interest rate is 4% and the US dollar interest rate is 3.5%, one would expect that the US dollar would appreciate by 0.5% per year in order for an investor to be indifferent between investing in Canadian dollars or US dollars.

In deriving market consistent volatilities on currency exchange rates, one main source would be the implied volatility based on available traded currency option prices. For example, the Montreal Exchange only offers currency options on the USD/CAD exchange rate with option expiration dates ranging up to one-year which would limit the observable period to up to one-year in this example. The observable period for currency exchange rate volatilities for many currencies may be limited due to a lack of available traded currency option prices.

Similar to how a Black-Scholes model is used to price stock options and a Black model is used to price interest rate options, an extended Black-Scholes model (i.e., Garman-Kohlhagen model) is typically used to price currency options. Actuaries therefore can derive implied volatility based on observed market prices using this extended Black-Scholes model.

Prices on longer-term currency options are not readily observable. Therefore, actuarial judgment is required to derive the ultimate market consistent volatility on currency exchange rates. Historical evidence indicates that the term structure of currency volatility increases with

[14] See Glossary of Terms.

[15] Referenced in the educational note – *Currency Risk in the Valuation of Policy Liabilities for Life and Health Insurers*.

term but decreases with the degree of integration of the economies of any two countries[16]. To derive ultimate market consistent volatility, actuaries could examine historical realized volatility of the exchange rate under consideration.

Similar to equity volatility discussed in Section 3.3.2, consideration would be given to adjusting the historical realized volatility assumption to reflect potential differences between long-term realized and implied volatility.

3.4.2 Correlations

When liabilities are a function of more than one index or currency, actuaries would consider correlations between these indices or currencies.

Actuaries would take into account appropriate correlation among investment returns for all market indices and proxies that are constructed, such as correlation between two equity market indices, between a bond market index and an equity market index, and to the extent applicable, between any foreign market indices and returns on currency exchange rates for the foreign currency under consideration.

Rainbow options, together with simple options, could in principle provide some data points for market consistent correlations. However, it would not be expected that there be any significant reliable information available from such sources, and even less likely for any term beyond a year.

Ultimate correlations could be calculated on market variables using historical data.

3.4.3 Inflation

As per IFRS 17.B59, "if cash flows allocated to a group of insurance contracts are sensitive to inflation, the determination of the fulfilment cash flows shall reflect current estimates of possible future inflation rates. Because inflation rates are likely to be correlated with interest rates, the measurement of fulfilment cash flows shall reflect the probabilities for each inflation scenario in a way that is consistent with the probabilities implied by the market interest rates used in estimating the discount rate."

When determining risk-free interest rate scenarios, actuaries would also determine, if needed, an assumption for the rate of inflation that is consistent with each interest rate scenario. Actuaries are also reminded that when projected liability cash flows reflect the effect of inflation (i.e., nominal cash flows), the cash flows would be discounted at rates that include the effect of inflation (i.e., nominal rates); and when projected liability cash flows do not reflect the effect of inflation, then they would be discounted at rates that do not include the effect of inflation (i.e., real rates).

Inflation swaps provide market consistent assumptions of inflation over the term of the swap. Alternatively, the difference between expected yields on nominal return bonds and expected yields on real return bonds could be indicative of a market consistent inflation rate for the given term. If these two sources are not available, the consumer price index could provide a starting point for short-term inflation expectations.

[16] Educational Note– *Currency Risk in the Valuation of Policy Liabilities for Life and Health Insurers*.

For the ultimate long-term inflation assumption, actuaries would consider country-specific monetary policy targets, especially if such policy targets are an input into ultimate levels for interest rates.

Inflation swaps with caps and/or floors could further provide market consistent inflation volatility assumptions. Alternatively, the volatility assumption would ordinarily be consistent with the volatility of short-term interest rates, recognizing that interest rates are often viewed as being the sum of inflation and real returns.

The actuary could consider simplifications, such as using a deterministic inflation assumption, where these simplifications provide a result within an acceptable degree of precision. For example, cash flow streams without material non-linearity due to inflation.

4 Adjustments to market prices

This section discusses adjustments to the market observable inputs discussed in the previous sections to reflect differences between the embedded options/guarantees and the market instruments used to derive the market observable inputs.

IFRS 17.B78 provides guidance on factors that can affect the discount rate:

> Discount rates shall include only relevant factors, ie factors that arise from the time value of money, the characteristics of the cash flows and the liquidity characteristics of the insurance contracts. Such discount rates may not be directly observable in the market. Hence, when observable market rates for an instrument with the same characteristics are not available, or observable market rates for similar instruments are available but do not separately identify the factors that distinguish the instrument from the insurance contracts, an entity shall estimate the appropriate rates. IFRS 17 does not require a particular estimation technique for determining discount rates. In applying an estimation technique, an entity shall:
>
> (a) maximise the use of observable inputs (see paragraph B44) and reflect all reasonable and supportable information on non-market variables available without undue cost or effort, both external and internal (see paragraph B49). In particular, the discount rates used shall not contradict any available and relevant market data, and any non-market variables used shall not contradict observable market variables.
>
> (b) reflect current market conditions from the perspective of a market participant.
>
> (c) exercise judgement to assess the degree of similarity between the features of the insurance contracts being measured and the features of the instrument for which observable market prices are available and adjust those prices to reflect the differences between them.

IFRS 17.B78(c) specifically highlights that the similarity between market instruments and the features of the insurance contracts being measured should be considered, and that (market consistent) prices should be adjusted to reflect the differences between them. IFRS 17.79 specifically introduces liquidity[17] as a potential difference.

[17] Guidance on liquidity adjustments can be found in the educational note *IFRS 17 Discount Rates for Life and Health Insurance Contracts*.

IFRS 17.B78(c) can also be extended to other aspects of the market consistent valuation in addition to discount rates and implied volatility (e.g., differing contractual features, etc. An example of an adjustment with respect to contract features is related to the minimum interest rate guarantees on universal life products. For these products, the minimum interest rate guarantees are typically only *indirectly* linked to interest rates through a crediting rate mechanism that is often company specific or proprietary in nature. For this example,

- the cost of these guarantees would need to be measured using a stochastic interest rate model as discussed in Section 2.3
- market consistent models would be calibrated as discussed in Section 3
- the market consistent accumulation rate and discount rate would both reflect any liquidity adjustment
- adjustments could be made to reflect the fact that contract features, that affect the cost of the guarantee, are not reflected in market instruments used to calibrate the ESG. For example, adjustments to the ESG output asset returns to reflect the crediting rate mechanism

Differences and adjustments in respect of participating insurance contracts are discussed in the educational note *IFRS 17 Measurement and Presentation of Canadian Participating Insurance Contracts*.

5 Segregated fund specific considerations

5.1 Measurement model

Insurance contracts that meet the definition of "*insurance contract with direct participation features*" are measured using the variable fee approach (VFA)[18] rather than the general measurement approach (GMA). There is no difference between the VFA and the GMA at initial recognition, however, the measurement of the contractual service margin (CSM) in subsequent periods is different – following IFRS 17.44 for the GMA and IFRS 17.45 for the VFA.

The definition of "*insurance contract with direct participation features"* appears in Appendix A of IFRS 17 as follows:

An insurance contract for which, at inception:

a) the contractual terms specify that the **policyholder** participates in a share of a clearly identified pool of **underlying items**;

b) the entity expects to pay to the **policyholder** an amount equal to a substantial share of the fair value returns on the **underlying items**; and

c) the entity expects a substantial proportion of any change in the amounts to be paid to the **policyholder** to vary with the change in fair value of the **underlying items**.

IFRS 17.B101–B109 provide application guidance for assessing whether an insurance contract meets this definition.

[18] Reinsurance contracts held cannot use the VFA, so even if the direct contract may qualify for VFA the reinsurance contract held or issued would not.

IFRS 17.BC238–BC249 provide important background for understanding the IASB's rationale in identifying those contracts for which the VFA was developed.

Chapter 8 of the educational note *Application of IFRS 17* Insurance Contracts provides additional guidance on these requirements.

The actuary would typically need to consider the following in making their assessment of whether the segregated fund contracts meet the definition of insurance contracts with direct participation features:

- Do the segregated funds meet the definition of a clearly identified pool of underlying items, and does the policyholder clearly participate in the performance of those funds?
- Does the policyholder receive a substantial share of the segregated fund market performance?
- Is a substantial part of the claim amount received by the policyholder dependent on the segregated fund market performance?

While it is expected that these conditions will be met in most cases, there may be situations where more explicit testing of these requirements is needed. This may need to occur for blocks of business that are significantly in-the-money and/or have material charges compared to the expected returns at the date of assessment. IFRS 17.B102 states that the conditions in the definition are assessed using the entity's expectations at inception of the contract and would only be reassessed if the contract is modified. This means that the date of assessment would typically be at the issuance of the contract but could be at a different time (e.g., transition to IFRS 17, acquisition of a block of contracts, a contract modification).

Segregated fund contracts that meet the definition of an insurance contract with direct participation features will be valued under the variable fee approach (VFA). Under the VFA approach, changes in the variable fee, defined as the entity's share of the underlying less fulfillment cash flows (e.g., expected amounts paid to the policyholder) adjust the CSM (where the CSM is positive). One exception to this is where risk mitigation (e.g., hedging, is in place) as discussed in the following section.

5.2 Risk mitigation exception

If an entity has a risk mitigation strategy that meets the guidance in IFRS 17.B116 that is used with respect to insurance contracts with direct participation features, then IFRS 17.B115 states that the entity "may choose not to recognise a change in the contractual service margin to reflect some or all of the changes in the effect of financial risk on:

a) the amount of the entity's share of the underlying items (see paragraph B112) if the entity mitigates the effect of financial risk on that amount using derivatives or reinsurance contracts held; and

b) the fulfilment cash flows set out in paragraph B113(b) if the entity mitigates the effect of financial risk on those fulfilment cash flows using derivatives, non-derivative financial instruments measured at fair value through profit or loss, or reinsurance contracts held."

The use of the risk mitigation exception can help to remove accounting mismatches.

IFRS 17 does not provide specific guidance on how to calculate the amount of financial risk that would go through the CSM versus profit (or loss). The following are potential methods that could be used:

Method	Description	Considerations
1	Transfer from CSM to profit (or loss) an amount equal to the change in fair market value of hedge assets	Hedge ineffectiveness is reflected in CSM Consistent with the fact that when there is no risk mitigation, there is no profit (or loss) impact when there is a CSM
2	Transfer from CSM to profit (or loss) an amount X such that (change in fair market value of hedge assets *less* X) is equal to the hedge ineffectiveness during the period	Hedge ineffectiveness is reflected in profit (or loss) The amount to transfer from CSM to profit (or loss) will be dependent on hedge ineffectiveness definitions and may be complicated to determine

Both approaches have their advantages and disadvantages, and the subcommittee is not able to provide explicit guidance at the current time regarding a recommended approach; however, the approach chosen should be applied consistently over time.

Risk mitigation cashflows used in the fulfilment cash flows may need to be allocated to each group and applied consistently in each reporting period (IFRS 17.B117).

Finally, if the conditions required to use this approach are no longer met then the approach cannot be used from that date; however, previous periods are not adjusted retrospectively (IFRS 17.B118).

5.3 Discount rate

5.3.1 Cash flows that vary/do not vary based on the returns on underlying item

According to IFRS 17, there are two types of cash flows: cash flows that vary with the financial underlying and cash flows that do not vary with the financial underlying. The type of cash flow will impact the discount rate that would be used.

The following is a non-exhaustive listing of cash flows that vary directly and do not vary directly with the underlying:

- *Cash flows that vary with the underlying:* MER, trailer fees, variable underlying fund expenses, etc.
- *Cash flows that do not vary with the underlying*: guarantee costs, guarantee fees based on benefit base, fixed general expenses, charge backs, fixed fees, etc.

Since segregated fund contracts contain both cash flows that vary and cash flows that do not vary based on the returns of the underlying items, these cash flows could be valued separately, or as described in IFRS 17.B77, the cash flows could be valued as a whole by applying a discount rate appropriate for the cash flows as a whole.

As described in IFRS 17.BC203, an asset-based discount rate (from assets with variable returns) would not be appropriate for cash flows that do not vary directly with returns on the underlying. Consequently, where cash flows are being valued as a whole, and contain cash flows that do not directly vary with the underlying, an asset-based discount rate would not be an appropriate discount rate to apply to cash flows as a whole. As described in IFRS 17.B77, stochastic modelling techniques or risk-neutral measurement techniques would instead be used to value these cash flows, where these techniques are discussed in Sections 2 and 3 of this educational note.

5.3.2 Liquidity adjustments

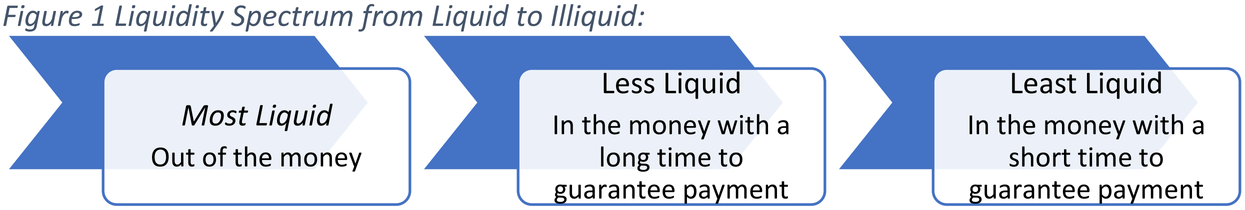
The educational note *IFRS 17 Discount Rate for Life and Health Insurance Contracts* provides guidance on how to set the liquidity characteristics of insurance contracts for the purpose of constructing discount rates.

The segregated funds in Canada have differing liquidity dynamics within the same contract, and these may vary materially over time.

- The account value is typically liquid, subject to surrender charges or other costs/restrictions on withdrawing funds, since the policyholder has access to their fund with limited exit costs.
- The guarantee, although uncertain, is typically illiquid since the policyholder can only access the guarantee at certain points in time.
- The inherent value/value build-up within the contract largely depends on the “in-the-moneyness” and the time remaining to the guarantee payment.

Figure 1 attempts to show a liquidity spectrum based on different characteristics:

Figure 1 Liquidity Spectrum from Liquid to Illiquid:



There is a material amount of judgement and complexity to determine and model the liquidity characteristics of segregate funds. It is expected that the majority of segregated fund business would fit into the “most liquid” bucket noted in the educational note *IFRS 17 Discount Rate for Life and Health Insurance Contracts*. The instances where the business would be classified in the “in between” or “least liquid” bucket would be as a result of specific circumstance. For example, once a GMWB contract is in the “lifetime annuity” phase, its characteristics, including the liquidity, would be similar to a single premium immediate annuity (SPIA) contract.

The subcommittee considers that swap spreads could be considered as a reasonable starting point from which to determine a liquidity adjustment in respect of segregated fund contracts:

- IFRS 17.B46 permits the use of a replicating portfolio technique to determine the fulfilment cash flows. Dynamic replication portfolio strategies typically use equity futures and interest rate swaps that are priced using the swap curve. The swap curve could therefore be viewed as a “market consistent” discount rate.

- From a policyholder perspective, it would be reasonable to conclude that unless the contract is deep in the money, that these contacts exhibit a low level of illiquidity. Swap spreads are typically low and would therefore be consistent with this viewpoint.

The educational note *IFRS 17 Discount Rate for Life and Health Insurance Contracts* provides guidance that during the observable period, liability liquidity adjustments could be determined based on the spread on assets with similar liquidity characteristics. Given that swaps usually have a high level of liquidity, swap spreads could therefore be considered a reasonable proxy to the liquidity adjustment on segregated fund contracts which are also liquid. It may be necessary to adjust the swap spread to account for credit risk.

Glossary of terms

Affine Term Structure Model:
A class of term structure models for which log bond prices are linear functions of the short rate, (i.e., where the yield for zero-coupon bond prices is a linear function of the short interest rate). This type of model is commonly used because of their tractability and their flexibility.

Antithetic variates:
A variance reduction technique that can be in a Monte Carlo simulation. To reduce the number of simulations (or scenarios) required for a given variance level, both the generated set of random variables and its counterpart is used in the Monte Carlo simulation. For example, the counterpart of a generated standard normal random variable *x* would be -*x*.

Deflator:
Path-dependent stochastic risk discount factor used in market consistent valuations employing real-world stochastic economic scenarios. It puts a greater weight on those scenarios in which assets perform badly. The riskiness and downside aversion that is experienced in the market valuation of assets is absorbed within the deflator values. This contrasts with risk-neutral valuations, where it is absorbed within the economic scenarios themselves.

Interest Rate Parity:
Interest rate parity is a theory in which the interest rate differential between two countries is equal to the differential between the forward exchange rate and the spot exchange rate.

LIBOR Market Model (LMM):
The LIBOR Market Model (LMM) is an interest rate model based on evolving LIBOR market forward rates. It assumes that the evolution of each forward rate is lognormal where each forward rate has a time dependent volatility and time dependent correlations with the other forward rates. After specifying these volatilities and correlations, the forward rates can be derived using Monte Carlo simulation.

Martingale:
The property wherein the expectation of the discounted (for the time value of money) future value is equal to the current value. For example, under a risk-neutral valuation, the expected future stock price, discounted for the time value of money, is the current stock price.

Monte Carlo simulations:
Monte Carlo methods, or Monte Carlo simulations, rely on repeated random (or more typically pseudo-random) sampling to obtain numerical results. Random samples are drawn from a probability distribution for each variable needed in the model and are combined in a model to produce hundreds or thousands of possible outcomes. Statistics are then calculated on these outcomes (e.g. average, VaR, CTE). A stochastic valuation of segregated fund guarantees is an application of Monte Carlo simulations.

Radon-Nikodym derivative:
Theorem that relates one probability space (e.g., risk-neutral) to another probability space (e.g., real-world).

Variance reduction techniques – Control Variates/Importance Sampling/Stratified Sampling:
The control variates method is a variance reduction technique used in Monte Carlo simulations that uses information about the errors in estimates of known quantities to reduce the error of

an estimate of an unknown quantity. Importance sampling is a general technique for estimating properties of a particular distribution, while only having samples generated from a different distribution than the distribution of interest. Stratified sampling is a method of sampling from a distribution which can be partitioned into subsets.

Additional reading and resources

Risk neutral pricing approaches
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Impact of offer, demand and liquidity on implied volatility
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Lapse
[1] Panneton CM, Boudreault M. 2011. Modeling and Hedging Dynamic Lapse in Equity-Linked Insurance: A Basic Framework. *Risk & Rewards*. Society of Actuaries.

Approximations
[1] Feng, R., Cui, Z. & Li, P. (2016). Nested stochastic modeling for insurance companies. Society of actuaries. Available at https://www.soa.org/globalassets/assets/files/static-pages/research/nested-stochastic-modeling-report.pdf.

Economic scenario generator
[[1] Feng R, Cui Z, Li P. 2016. *Nested Stochastic Modeling for Insurance Companies*. Society of Actuaries. Available at https://www.soa.org/globalassets/assets/Files/Research/Projects/research-2016-economic-scenario-generators.pdf

Martingales
[1] Jarrow RA. 2018. *Continuous-Time Asset Pricing Theory: A Martingale-Based Approach*. Springer.
[2] Williams D. 1991. *Probability with Martingales*. Cambridge.