*Exposure Draft*

# Determination of Pension Commuted Values in Economic Environments Where Bond Yields are Negative

## Actuarial Standards Board

**May 2021**

Document 221056

*Ce document est disponible en français*

# MEMORANDUM

**To:** All Fellows, Affiliates, Associates and Correspondents of the Canadian Institute of Actuaries, and other interested parties

**From:** Josephine Marks, Chair
Actuarial Standards Board

Marshall Posner, Chair
Designated Group

**Date:** May 29, 2021

**Subject:** **Exposure Draft Regarding the Determination of Pension Commuted Values in Economic Environments where Bond Yields are Negative**

**Comments Deadline: July 30, 2021**

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This exposure draft (ED) proposes changes to Section 3500 of the *Standards of Practice*, which applies to the actuary's advice on the computation of commuted values with respect to pension plans. On May 26, 2021, the Actuarial Standards Board (ASB) approved the ED. The ASB and its Designated Group have followed the ASB's due process in the development of this ED.

On November 25, 2020, the ASB established the Designated Group on Pension Commuted Values when Bond Yields are Negative (DG). The CIA posted a notice of intent (NOI) to the CIA website on January 28, 2021. Readers should refer to the NOI for background on the issue. The NOI had a comment deadline of February 19, 2021. Appendix A of this ED contains a summary of the comments submitted along with the DG's responses.

Commuted values for pensions payable from target pension arrangements were not included in the scope of the DG's review.

Since January 2021, yields on Government of Canada (GoC) long-term real return bonds have increased from lows experienced in the months leading up to November 2020, and, at the time of this ED's publication, are above zero again. Yields on GoC non-indexed bonds have also increased since that time. Some may believe the issue identified in the NOI has therefore disappeared and/or reductions in GoC bond yields are unlikely in the near term. But negative yields persist in real return bonds with shorter maturities and in bonds issued by governments of other countries. Negative yields on long term bonds could recur in Canada. Even if negative yields on long-term real bonds do not recur, in conducting its research, the DG concluded that an adjustment to the approach for calculating the commuted value standard's pension escalation assumption would be appropriate. The DG believes it remains prudent to adjust the formula for $r_7$ and to do so reasonably promptly.

Please note: the analysis described in this document was completed prior to the Bank of Canada revising their posted long-term real return bond yields for June 2020 to April 2021. The DG is satisfied that had it used the revised rates, the conclusions would be unchanged.

## Preferred approach

The NOI includes two possible approaches to address the DG's mandate. They were:

> 9*i.* For abnormal economic environments such as the one at the time of the publication of the NOI where $r_L$ was negative, **$r_7$ is assigned a value equal to $r_L$**. $r_7$ would retain its current form in normal economic environments.
>
> 9*ii.* For *any* economic environment, **$c_{1\text{-}10}$ and $c_{10+}$ are both assigned a value equal to $(1+i_L)/(1+r_L) - 1$**. The formula for $r_7$ would be eliminated.

Upon reviewing all comments on the NOI (summarized in Appendix A), and studying the matter further, the DG has a strong preference for approach 9*ii*. The DG is also proposing to establish a floor of zero on the nominal interest rates used to calculate commuted values. In arriving at these recommendations, the DG had the following rationale:

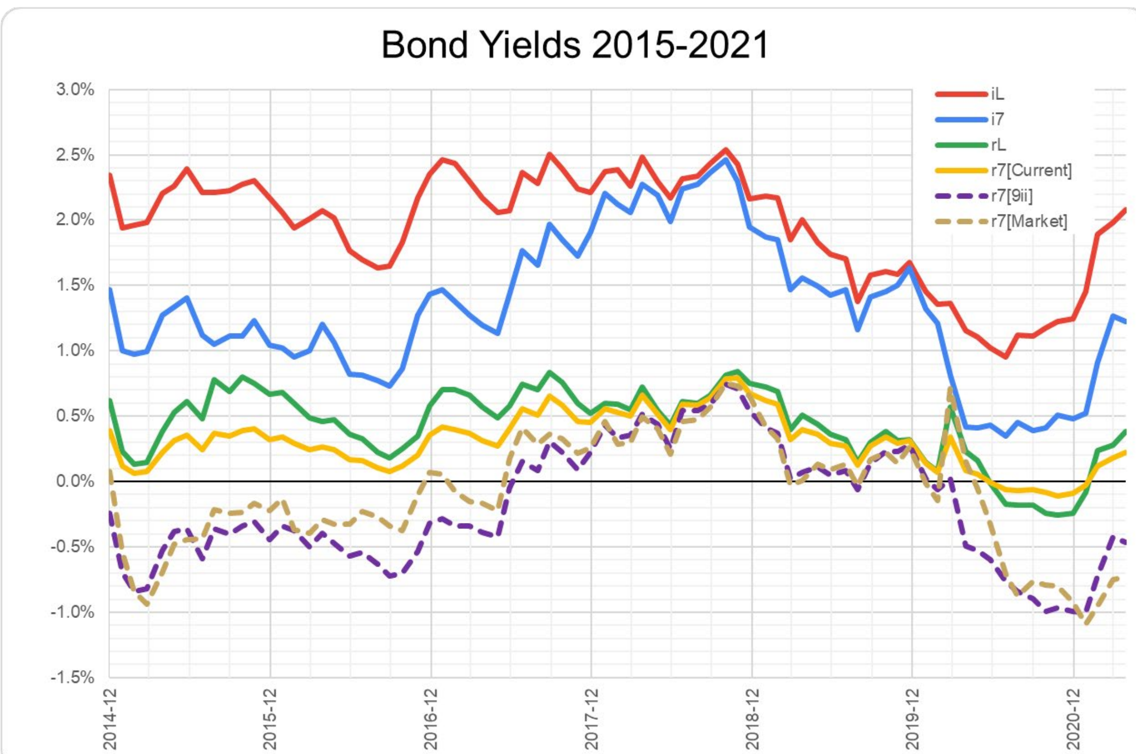
1. The main issue at hand exists predominantly in the formula for $r_7$ and its derivative values $c_{1\text{-}10}$ and $c_{10+}$. If a monthly data series representing real return GoC bond yields whose duration were to reasonably match the duration of the bond that is used to derive $i_7$ were to be publicly available, the DG's preference might be to set $r_7$ directly from that data series, and not adopt either of approaches 9*i* or 9*ii*. Establishing $r_7$ directly from market data, and not from a combination of $r_L$, $i_7$ and $i_L$, would be consistent with the method in the current standards for determining $r_L$, $i_7$ and $i_L$.
2. While they did not exist a decade ago, there are now real return GoC bonds in the market with maturities of seven years or less. For example, 30-year bonds which were originally issued in 1996 and 2001 and mature in December 2026 and December 2031, are the bonds closest (at the time of this publication) to having seven years remaining to maturity. One can interpolate between these two sets of data points to arrive at an implied yield for a real return GoC bond, say, with a maturity or duration that matches the maturity or duration of the bond used to derive $i_7$, or a term to maturity of exactly seven years. However, the lack of a simple approach, the relatively small number of available market data points, and the fact that this data is not publicly available all present challenges. The methodology contained in subsection 3540 must be practical for widespread use.
3. One potential solution would be for the Bank of Canada to create, publish, and maintain a new data series to emulate market yields for seven-year real return

bonds, just as they do for the other CANSIM series referenced in subsection 3540. The DG contacted the Bank of Canada and it appears that there is no current plan to publish such information.

4. Another potential solution would be for the CIA to engage with a third party to publish data so that the data may be used in a calculation of $r_7$. The DG contacted FTSE Russell to discuss publication of new data (in addition to the data they already publish monthly to fulfil the liquidity spreads portion of the commuted value standards). FTSE Russell was open to discussing the idea. This gave the DG a third approach to consider.

5. The DG reviewed an analysis of historical GoC annualized bond yields prepared by Fiera Capital (and the DG is grateful for all of their work) based in part on data Fiera Capital sourced from FTSE Russell. The DG supplemented Fiera Capital's work with its own analysis. The data used for the analysis cover the period since December 2014 – the first month there was a remaining term to maturity on any GoC real return bonds of less than seven years.

6. The line graph below shows the monthly history since 2015 of the three values $i_7$, $i_L$ and $r_L$, plus three values for $r_7$:
   - The approach in the current standards ($r_7 = r_L * i_7 / i_L$).
   - The approach effectively proposed as 9*ii* in the NOI ($r_7 = (1+r_L)*(1+i_7)/(1+i_L)-1$).
   - A potential approach using market data (in this case, the interpolation described in paragraph 2 above using a term to maturity of exactly seven years).

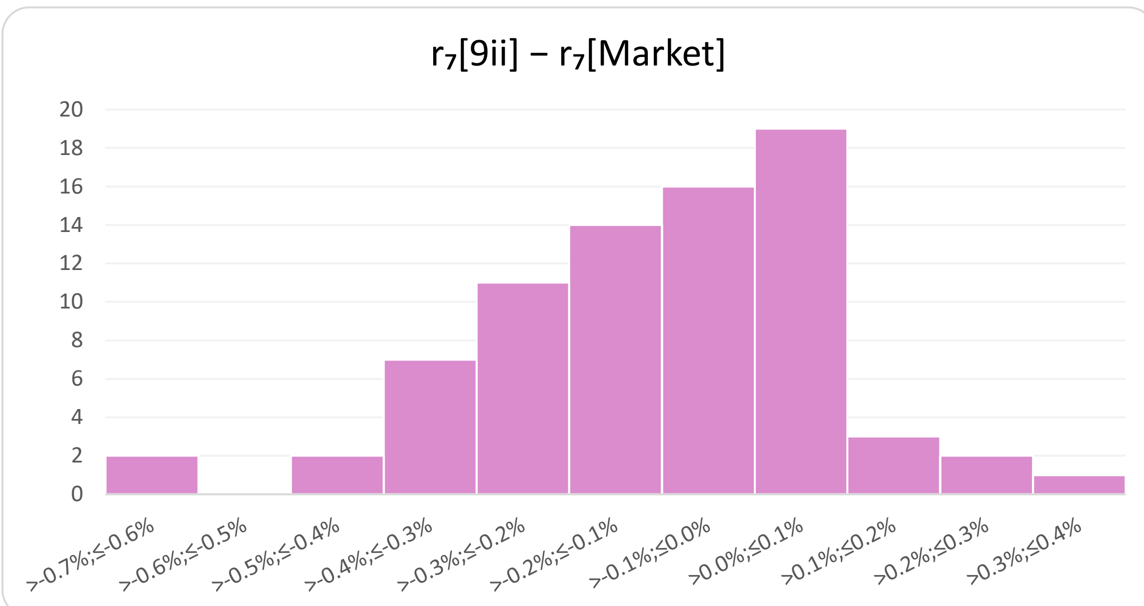


Approach 9*i* is not shown on the graph. If it were, the line would overlap with $r_7$ under the current approach for all months except July 2020 to January 2021 where it would overlap with $r_L$.

If the $r_7$ approach using market data is a reasonable reflection of the method the marketplace might use to establish an economic value of the obligations discharged by a pension plan, then the data show:

- $r_7$ in the current standards has almost always been too high since December 2014; and
- the $r_7$ approach proposed as 9*ii* has been much closer to the market approach.

The histogram below shows a distribution of all 77 data points of the difference between $r_7$ under the 9*ii* approach and $r_7$ under the market approach. The median is -0.06%, the average is -0.10% and the two values are within +/-0.2% of one another 68% of the time. The leftward skew is mostly driven by the data between July 2015 and August 2017.




The graphs above suggest that the 9*ii* approach is a reasonable approximation of the market approach. The leftward skew in the data also suggests that the 9*ii* approach tweaked by an upward 0.1% adjustment, may be a slightly better approximation of the market approach, since that results in a median (0.04%) and average (zero) of their difference which are even closer to zero than the unadjusted 9*ii* approach.

7. The DG next assessed the various approaches from the perspective of their resulting commuted values, comparing them to an "ideal" commuted value. With the data available, the DG used the entire nominal and real yield curves to construct <u>a complete market inflation curve</u> for every month from December 2014 to February 2021. The DG then used the complete market inflation curve (and the current Standards' nominal interest rates) to define an ideal commuted value. While all of the alternatives considered represent an improvement over the current Standards,

**the 9*ii* approach, without adjustment, results in the closest approximation to the ideal commuted value**, accounting for a range of plan participant ages, and for plans both with and without escalation during the deferral period. Appendix D contains additional details of the results of the analysis.

8. The DG's preference for the proposed approach is based on the independent reasonability of the inflation assumption. The two-tier approach for nominal yields is itself an approximation and the deviation using a two-tier approach in lieu of the full yield curve is, in some instances, offset by the current two-tier approach to inflation (in lieu of a full expected inflation curve). If the full real yield curve is taken as the theoretical ideal benchmark for determining the ideal commuted value for a fully indexed pension, then the approximation deviation in the proposed approach, in fact, may be larger than the current approach. A review of the two-tier approach for nominal yields was beyond the scope of the DG's mandate, but the DG is satisfied that the use of the currently stipulated approach to nominal yields and the proposed approach to inflation is reasonable in aggregate.

9. The DG acknowledges some shortcomings of this analysis:

   - The data are only composed of 75 observation points from 2014 to 2021. It is impossible to know if this time period will be representative of future financial market conditions. However, within this 6+ year period, the inflation curve distinctly changes position and shape several times.
   - The complete market inflation curve is composed of the marketplace's expectation of inflation, plus other variables, such as differences in liquidity between nominal and real bonds, supply and demand imbalances, and an inflation risk premium. However, since a commuted value is to represent an estimate of the value that the marketplace would attribute to the pension that would have been payable from the pension plan, it is reasonable to use the marketplace's implied inflation as a proxy for the marketplace's cost of inflation protection of a pension.

10. **Setting $r_7$ to $(1+r_L)*(1+i_7)/(1+i_L) – 1$** is mathematically equivalent to how approach 9*ii* is described in the NOI (this is also equivalent to $r_7 = (1+i_7)/(1+BEIR) – 1$). If $r_7$ is set this way, then there is no need to adjust the formulas for $c_{1\text{-}10}$ and $c_{10+}$. That is, $c_{1\text{-}10}$ and $c_{10+}$ are equivalent to $(1+i_L)/(1+r_L) − 1$, or BEIR. An advantage to leaving the formulas for $c_{1\text{-}10}$ and $c_{10+}$ unchanged and continuing to define $r_7$ allows for an opportunity for a future designated group or task force to study and, if necessary, update how $r_7$ is determined.

11. Two NOI commenters suggested that nominal interest rates should be prohibited from being negative. Another commenter suggested further analysis of the impacts of negative nominal rates. While the Bank of Canada has never used negative short-term interest rates to provide monetary stimulus, this possibility cannot be ruled out. Negative nominal yields on government and even corporate bonds with longer terms have arisen in other countries, but it is difficult to conceive of circumstances that would lead to yields on GoC seven-year and long-term bonds that are more

negative than the liquidity spreads in the commuted value standards. The rationale for anyone to purchase a bond in an economy where yields are that negative would either be to defease a long-term obligation with a highly liquid instrument or to protect against prolonged deflation.

A pension commuted value represents the economic value of a highly secure, but highly illiquid, future cash flow. In a situation where long nominal corporate bonds have negative yields, the recipient of the commuted value can keep the cash and draw the income without any investment. Essentially, a floor of zero on nominal interest rates used to determine commuted values can be regarded as an upward adjustment to the liquidity spread adjustments of paragraph 3540.06.2. The DG does not believe that the liquidity spread adjustments in 3540.06.2 are sufficient in a situation that results in negative nominal interest rates for commuted values.

For these reasons, the DG proposes to update the Standards to **impose a floor of zero on $i_{1\text{-}10}$ and $i_{10+}$**.

It is acknowledged that these conclusions are based on hypothetical circumstances that do not currently exist anywhere in the world. Where negative interest rates do exist, they pertain mostly to sovereign debt, and mostly to short-term debt. Negative long-term corporate bond yields are difficult to envision. If the floor of zero were to impact commuted values for a prolonged period for reasons other than those anticipated by the DG, it should be reevaluated based on those new circumstances.

12. Paragraph 3540.04 requires the commuted value of an indexed pension to be no smaller than the commuted value of a non-indexed pension, presumably even in a period of sustained deflation. The DG does not propose to change this floor on indexed commuted values. In a deflationary environment where a fixed nominal pension is more valuable than a pension that is expected to decline in line with Consumer Price Index (CPI) (or would do so if this were permitted by regulations and plan documents), the absence of an indexing provision should not increase the value of the pension.

## Summary of proposed changes

In summary, the DG is proposing to:

- adjust the formula for $r_7$ to $(1+r_L)*(1+i_7)/(1+i_L) - 1$; and
- apply a floor of zero to the two nominal interest rates $i_{1\text{-}10}$ and $i_{10+}$.

These changes would apply for all commuted values with a calculation date on or after an effective date to be specified.

Appendix B shows these changes in the Standards directly.

## Impacts on commuted values

The size and direction of the proposed change to $r_7$ is heavily dependent on the plan member's age, market yields on government bonds and the indexing formula. It is also somewhat affected by early retirement provisions, the normal form of pension, mortality and term spreads.

With this context, Appendix C contains sample present value factors to illustrate the potential impact on commuted values of the proposed changes to Standards. Other than in situations where an interest rate floor of zero might apply, commuted values of pensions which do not include inflation-related escalation (related to either the CPI or average wage index) are not affected.

The DG acknowledges for some pension plans, the proposed change may also impact the calculation of optional forms, solvency liabilities, minimum funding requirements, and wind-up benefits.

## Timeline

There remains some urgency of effecting an appropriate change to the Standards in the event that bond yields decline significantly again.

After considering comments and feedback received on this exposure draft, the ASB will target to publish a final version of the revisions to Standards in late summer or early fall 2021. Unless market conditions compel an earlier effective date, the DG's expectation is for the final Standards to have an effective date in late 2021 or early 2022. Early implementation will not be permitted.

## Desired feedback

The DG and ASB are soliciting feedback on this exposure draft from members of the CIA and any other interested groups.

Feedback is welcomed on the commentary above plus the following questions:

1. Do you agree with the proposed change to $r_7$? If not, what would you suggest?
2. Do you agree with the proposed restriction (i.e., floor of zero) to $i_{1\text{-}10}$ and $i_{10+}$?
3. Can plan administrators implement the change(s) in the time frame envisioned?

Please send comments **by July 30, 2021,** to Marshall Posner at marshallposner@gmail.com, with a copy to Chris Fievoli at chris.fievoli@cia-ica.ca. No other forums for obtaining feedback are contemplated at this time.

The members of the DG are Lydia Audet, Gavin Benjamin, Doug Chandler, Marshall Posner (Chair), and Jingjing Xu.

JEM, MP

## Appendix A: Summary of the comments received on the notice of intent and the DG's responses

Fourteen parties submitted comments on the NOI: 6 are individual CIA members, six are pension consulting firms, one is a group of public sector pension plan administrators and one is an industry association. The DG appreciates very much the feedback received.

Commenters generally submitted their feedback as responses to the four questions posed in the NOI.

1. *Do you agree that the existing formula for estimated $r_7$ should be reconsidered when interest rates are negative, and that an adjustment is in order?*

Eleven out of 14 commenters agreed that the formula for $r_7$ needed to be reviewed and updated now. Some of these commenters suggested the change should be to an easily determined result, consistent with economic theory, and not result in inappropriate estimates in some economic conditions.

One commenter disagreed that changes were necessary at all, citing the current formulas are aligned with market data.

Two commenters suggested that changes would be necessary but only for negative values of $i_7$ or $i_L$, noting that the Bank of Canada does not intend to lower interest rates, concluding there is ample time before a change to the current formulas is necessary.

The DG agrees with the majority of commenters that the formulas need to be reviewed in light of the recently-experienced negative real return bond yields, and updated to take into consideration the observed market data. Doing so would better align pension commuted values with what they are intended to be: a marked-to-market assessment of the economic value of the cash flow payable by the pension plan that the former member is forgoing.

The DG respectfully rejects the argument that "the Bank of Canada does not intend to lower interest rates" so these changes should be deferred. While Bank officials have expressed concerns with the ineffectiveness and adverse side effects of negative overnight interest rates, as recently as December 10, 2020, Deputy Governor Paul Beaudry said, "In theory, negative interest rates remain in the bank's tool kit." Negative overnight interest rates could translate into negative mid-term and long-term bond yields if they were expected to persist. Germany, France, and six other European countries currently have negative 10-year bond yields. The possibility of this occurring in Canada cannot be ignored.

2. *If you agree that the formula for r7 should be modified, do you prefer the approach in paragraph 9i or in paragraph 9ii above and why? If neither, what other approach would you suggest?*

There was no consensus among commenters on this question.

Four commenters preferred 9*i*, with the main reasons being:

- the current formula appears to be correct in “normal” economic environments;
- a preference to keep a select and ultimate inflation rate;
- the minimal impact to commuted values (versus 9*ii*); and
- it is a reasonable temporary solution while more research is conducted for a permanent solution.

Reasons given by these commenters why they did not prefer 9*ii*, included:

- the material impact 9ii has on commuted values;
- it would be unusual to have two nominal non-indexed rates, but only one inflation rate; and
- if 9ii is applied only in abnormal economic environments, there will be additional commuted value volatility when bond yields are low.

Five commenters preferred 9*ii*, with the main reasons being:

- it corresponds to the evidence that the BEIR is relatively level at most points along the yield curves of GoC bonds;
- it applies in all economic conditions, which reduces complexity (versus 9i);
- it is derived from the observed price of inflation protection in the bond market;
- it is easier to communicate a flat inflation assumption than a select and ultimate assumption; and
- it reflects the limits of the Canadian real return bond market.

There were many reasons given by these commenters why they did not prefer 9*i*, the main ones being:

- abnormal economic environments are subjective;
- 9i would require more communications to members than 9ii;
- 9i does not deal with situations where $i_7$ is negative and $r_L$ is negative but greater than $i_7$;
- 9i is not representative of the real implicit inflation and real rates in the short term;
- assigning $r_7$ a value equal to $r_L$ implies no maturity premium for the long-term rate; and
- 9i does not solve the issue of price deflation.

Two commenters suggested the rates of pension escalation in subsection 3540 should reflect the Bank of Canada’s target inflation rate, or another similar long-term assumption for future inflation. One of these commenters’ reason was that this would have a stabilizing effect on month to month volatility.

Two commenters suggested the CIA or a third party regularly publish actual rates for $r_7$ based on market yields on real return bonds with around seven years to maturity.

Three commenters expressed no preference for either approach, but that further in-depth analysis would be necessary first.

The DG prefers 9*ii* for the reasons given in this document. The DG sympathizes with a preference to minimize the impacts to commuted values, and that 9*i* would have smaller impacts than 9*ii*, however the DG prefers a robust solution with lasting soundness over one which minimizes impacts in the short term. The DG acknowledges the calls for more research, and indeed has provided herein data from the DG's additional research. The DG believes further analysis at this time will not lead to a materially different solution from the one proposed. The DG encourages the next designated group that reviews Section 3500 to continue monitoring this matter.

The DG respectfully rejects the argument to reflect the Bank of Canada's target inflation rate as doing so would not be aligned with a marked-to-market assessment of the pension's economic value. Furthermore, the DG feels adding the Bank's target inflation rate to standards would unnecessarily deviate too much from current practice at this time. The DG recommends to the commenters who suggested this, to raise it at the next major review of Section 3500.

The DG looked into the possibility of publishing market data that could be used to derive $r_7$, including encouraging the Bank of Canada to expand its set of published bond yield series. These investigations were not productive and ended because the DG's research led towards not needing the data published after all.

3. *Will a change to any of the formulas in subsection 3540 which are mentioned above, on short notice, cause problems for plan administrators to implement?*

There was a wide array of responses to this question. Some commenters said the updates could be made without any major problems (some approximated they would need only one or two months). Others suggested that major system reprogramming could be necessary.

The DG inquired further with commenters who said a major reprogramming would result. The commenters said that negative real discount rates would be problematic because administration systems cannot accommodate them. Any change requires significant lead time to schedule coding, testing, and implementation.

The DG will carefully consider the effective date for final standards balancing the time needed for administrators to implement the change, with any urgency to modify the existing standards given the then-prevailing economic environment. In the meantime, the DG strongly encourages administrators to check that their administration systems function when there are negative real discount rates. Negative real discount rates have always been a possibility even under the current standards. With the details of the proposed change clearer in this exposure draft than they were in the NOI, the DG seeks feedback on this question again.

4. *Do you have any other comments on the above observations and thoughts?*

One commenter did not see the need for any change given that the abnormal environment is likely to be short-lived. The DG cautions against this thinking. At the time of this exposure draft's publication, bond yields have indeed increased to a level such that proposal 9*i* would not consider the current economic environment to be "abnormal," but it is far too speculative to imply that negative yields will never recur.

Several commenters objected to the phrase “abnormal economic environment” or the lack of clarity about what constitutes one. Some did not like the concept of one formula that would apply in abnormal environments and another formula in normal environments. These are fair critiques. It would have been the DG’s intent under approach 9*i* to avoid formulas that are discontinuous between abnormal (e.g., any of $i_7$, $i_L$ or $r_L$ are zero or negative) and normal (e.g., all of $i_7$, $i_L$ and $r_L$ are positive) environments.

One commenter suggested using full yield curves. The DG believes that a solution which adds more tiers to the interest rates and/or pension escalation rates, or adds complexity to the derivation of the current two tier structure, would be strongly resisted by practitioners. Making this refinement for indexation assumptions alone while continuing to use a two-tier approach to nominal interest rates is neither practical nor effective.

Two commenters suggested putting a floor of zero on nominal interest rates. The DG was intrigued by this comment and discussed it at length. The DG ultimately decided to propose such a change to the Standards. Refer to paragraph 11 in the main section of this exposure draft.

One commenter suggested revising paragraph 3540.16 to limit the range of acceptable practice to address differing results depending on the models used. A pension plan’s floor of 0% on inflation adjustments would be covered by 3540.16, and the potential for deflation is likely greater when nominal interest rates are low or negative or when the BEIR is negative. Thus, low or negative bond yields could lead to broader application of 3540.16, especially if deficiencies are not carried forward to later years. While the DG commends the commenter for raising the matter, the DG does not believe that the issue they raised, or the interpretation of 3540.16, is affected by proposal 9*ii*. Unlike Japanese JGBi bonds, Canadian RRB bonds do not have a floor on their maturity price, and so could theoretically mature for less than their original base price.

Some commenters noted that approach 9*ii* would result in material reductions in commuted values, and moreover that the proximity of this change to the last commuted value standards change, would result in poor optics for the CIA, and frustration from plan sponsors and others. While the DG acknowledges the concerns, the DG, and the ASB, believe that “doing the right thing” trumps a potential unfavourable perception.

One commenter said that there would be additional administrative costs to plans to implement either change in the NOI. The DG has deliberately kept the changes to a minimum, therefore costs to implement should not be significant.

One commenter suggested looking at the inflation curves in the US and UK bond markets. The DG did so and provides its observations in Appendix E.

Some commenters expressed concern that another change to the commuted value standards is being adopted so soon after the changes adopted in December 2020, and a “tweak” to fix a problem that might not recur, can wait until the next major review. Others took the view that emerging data for mid-term real-return bonds represent an opportunity for improvement in the existing Standards that should not be ignored. The DG accepts the latter view and is satisfied the change being proposed represents a more robust approach under all market conditions. The DG observes that the changes implemented effective December 2020 were initiated in 2015 and finalized in early 2020. The next major review of the commuted value standards may not begin for some time.

## Appendix B: Proposed Changes to Standards

All the paragraphs of subsection 3540 are reproduced below, marked with the DG's proposed changes.

### 3540 Economic Assumptions

.01 Economic assumptions that vary depending on whether the pension is fully indexed, partially indexed, or non-indexed should be selected. For commuted values calculated in accordance with subsection 3570, the economic assumptions should be determined in accordance with subsection 3570. [Effective December 1, 2020]

.02 Economic assumptions should be selected based on the reported rates for the applicable CANSIM series for the calendar month immediately preceding the month in which the valuation date falls. [Effective December 1, 2020]

.03 Two interest rates and two rates of pension escalation, when applicable, should be calculated. The first rate is applicable to the first 10 years after the valuation date and the second is applicable to all years thereafter. [Effective December 1, 2020]

.04 The commuted value of a fully or partially indexed pension should be at least equal to the commuted value applicable to a non-indexed pension in the same amount and having similar characteristics. [Effective April 1, 2009]

.05 The following three factors should be determined from the CANSIM series:

| CANSIM Series | Description | Factor |
|---|---|---|
| V122542 | Seven-year Government of Canada benchmark bond yield, annualized (final Wednesday of month) | $i_7$ |
| V122544 | Long-term Government of Canada benchmark bond yield, annualized (final Wednesday of month) | $i_L$ |
| V122553 | Long-term real-return Government of Canada bond yield, annualized (final Wednesday of month) | $r_L$ |

Note that the factors determined above are not the reported CANSIM series, but the annualized value of the reported figure. [Effective December 1, 2020]

.06 A fourth factor should also be determined as follows:

~~$r_7 = r_L * (i_7 / i_L)$~~

$r_7 = (1 + r_L) * (1 + i_7)/(1 + i_L) - 1$

[Effective Month XX, 2021 ~~December 1, 2020~~]

.06.1 Four bond yield spreads should be determined, based on the index yields for the final Wednesday of the calendar month immediately preceding the month in which the valuation date falls, calculated as follows:

$PS_{1-10}$ = (Canada Mid-term provincial bond index yield, annualized) – (Canada Mid-term federal non-agency bond index yield, annualized)

$CS_{1-10}$ = (Canada Mid-term corporate bond index yield, annualized) – (Canada Mid-term federal non-agency bond index yield, annualized)

$PS_{10+}$ = (Canada Long-term provincial bond index yield, annualized) – (Canada Long-term federal non-agency bond index yield, annualized)

$CS_{10+}$ = (Canada Long-term corporate bond index yield, annualized) – (Canada Long-term federal non-agency bond index yield, annualized)

The bond index yields, before being annualized, referred to in this paragraph 3540.06.1 are the average semi-annual mid market yields to maturity for each index published by FTSE Canada Debt Capital Markets at the market close on the final Wednesday of the calendar month immediately preceding the month in which the valuation date falls, or such other bond index yields or calculation bases that may be promulgated from time to time by the Actuarial Standards Board for purposes of these calculations.

The bond index yields used to calculate $PS_{1-10}$, $CS_{1-10}$, $PS_{10+}$, or $CS_{10+}$ are not the yields published, but the annualized value of the published figures.

If $PS_{1-10}$, $CS_{1-10}$, $PS_{10+}$, or $CS_{10+}$ as calculated above is less than zero, the bond yield spread should be set equal to zero. [Effective December 1, 2020]

.06.2 Two spread adjustments should be determined as follows:

$$s_{1-10} = (0.667 * PS_{1-10}) + (0.333 * CS_{1-10})$$

$$s_{10+} = (0.667 * PS_{10+}) + (0.333 * CS_{10+})$$

If $s_{1-10}$ or $s_{10+}$ as calculated above is more than 1.5%, the spread adjustment should be set equal to 1.5%. [Effective December 1, 2020]

.07 The following interest rates should be used to calculate commuted values:

| | Interest rates |
|---|---|
| First 10 Years | $i_{1-10} = i_7 + s_{1-10}$ |
| After 10 Years | $i_{10+} = i_L + 0.5 * (i_L - i_7) + s_{10+}$ |

If $i_{1-10}$ or $i_{10+}$ as calculated above is less than zero, that interest rate should be set equal to zero. [Effective Month XX, 2021~~December 1, 2020~~]

.08 Repealed

.09 For pensions that are fully indexed to increases in the Consumer Price Index the rates of pension escalation should be determined based on the implied rates of increase in the Consumer Price Index for any escalation falling within the first 10 anniversaries of the valuation date inclusive, and thereafter determined as follows:

| | **Implied rates of increase in CPI** |
|---|---|
| First 10 Years | $c_{1\text{-}10} = (1+i_7) / (1+r_7) - 1$ |
| After 10 Years | $c_{10+} = (1+i_L + 0.5 * (i_L - i_7)) / (1+r_L + 0.5 * (r_L - r_7)) - 1$ |

[Effective December 1, 2020]

.10 For pensions that are partially indexed to increases in the Consumer Price Index, the rates of pension escalation should be determined by applying the partial indexing formula of the plan to those rates of increase in the Consumer Price Index, determined in accordance with paragraph 3540.09. [Effective December 1, 2020]

.11 Where rates in pension escalation are related to increases in the average wage index, it should be assumed that the average wage index will increase at rates that are one percentage point higher than the rates of increase in the Consumer Price Index. [Effective December 1, 2020]

.12 A pension that is indexed according to an excess interest approach involves increases that are linked to the excess of formula A over formula B, where A is some proportion of the rate of return on the pension fund or on a particular class of assets, and B is a base rate or some proportion of the rate of return on another asset class. In determining the interest rates under formula A and formula B, the interest rates determined in accordance with paragraph 3540.07 should be used as proxies for the rate of return on the pension fund or on any particular asset class for which the rate of return is expected to be equal to or greater than the non-indexed interest rates determined in accordance with paragraph 3540.07. [Effective December 1, 2020]

.13 Prior to calculating the commuted value, the rates of interest and/or rates of pension escalation determined in accordance with this subsection 3540 should be adjusted using either of the following approaches:

- Round each of the rates of interest and rates of pension escalation to the nearest multiple of 0.10%; or
- Round to the nearest multiple of 0.10%
  - The rates of interest, and
  - The compound difference between the rates of interest and the rates of pension escalation (the "rounded interest rates net of pension escalation").

  The final rates of pension escalation would then be determined based on the compound difference between the rounded rates of interest and the rounded interest rates net of pension escalation. This approach produces rounded interest rates, unrounded rates of pension escalation and rounded interest rates net of pension escalation.

Any rates of interest, increase, or escalation used in calculations prior to the final step of the determination should not be rounded. [Effective December 1, 2020]

**Pension index frequency**

.14 Reasonable approximations may be used to take into account the specific circumstances of the situation regarding payment frequency, indexing frequency, and time and amount of the first increase of pension escalations.

**Pension indexed on an excess interest formula**

.15 If the pension is indexed on an excess interest formula and the particular asset class is one for which the rate of return is expected to be less than the interest rates determined in accordance with paragraph 3540.07, in determining the expected rate of return on a particular asset class for this purpose, the current economic environment as well as future expectations would be considered.

**Other modifications**

.16 Where pension escalation rates are either modified by applying a maximum or minimum annual increase, with or without carry forward of excesses or deficiencies to later years, or modified by prohibiting a decrease in a year where the application of the formula would otherwise cause a decrease in pension, the pension escalation rates otherwise applicable would be adjusted, based on the likelihood of the modification causing a material change in the pension payable in any year. In determining such likelihood, the current economic environment as well as future expectations would be considered. Either a stochastic or deterministic analysis may be used to determine the pension escalation rates.

.16.1 Where pension escalation rates are based on the funded status of the pension plan, the pension escalation rates otherwise applicable would be adjusted, based on the likelihood of the plan's funded status causing a material change in the pension payable in any year. In determining such likelihood, the current funded status of the plan and the projected funded status in future years would be considered in determining the pension escalation rates. A stochastic or deterministic analysis may be used to determine the pension escalation rates.

.17 Where pension escalation rates are not determined by reference to increases in the Consumer Price Index, the commuted value would be consistent with the values of non-indexed pensions and fully indexed pensions.

**Alternative calculation method**

.18 Repealed.

## Appendix C: Sample impacts on commuted values

Table 1 in this appendix displays Bank of Canada derived rates from some recent months (including where $r_L$ is negative, rows are highlighted in orange), some historic months, and two hypothetical months where rates are lower than they are at the time of the publication of this exposure draft (rows highlighted in grey). The historic months selected are a valid representative sample of that time period. Table 1 also displays the current value for $r_7$ and proposed value for $r_7$ as if the proposal applied in that month. Tables 3 and 4 display sample commuted value factors for a plan with CPI indexing under the current standards and the proposed standards based on rates from Table 2. Table 5 displays sample commuted value factors for a plan with no indexing under the current standards and the proposed standards for hypothetical month HM2.

Table 1: Rates from paragraph 3540.05 and current and proposed rates for $r_7$ from paragraph 3540.06. All values in %.

| **Month of calculation** | **$i_7$** | **$i_L$** | **$r_L$** | **$r_7$** | |
|---|---|---|---|---|---|
| | | | | **Current** | ***Proposed*** |
| HM2 | -0.74 | -0.03 | -1.72 | -42.17 | *-2.41* |
| HM1 | 0.26 | 0.97 | -0.72 | -0.19 | *-1.42* |
| Apr 2021 | 1.26 | 1.98 | 0.28 | 0.18 | *-0.42* |
| Mar 2021 | 0.91 | 1.89 | 0.24 | 0.12 | *-0.72* |
| Feb 2021 | 0.52 | 1.46 | -0.08 | -0.03 | *-1.00* |
| Jan 2021 | 0.48 | 1.24 | -0.24 | -0.09 | *-0.99* |
| Nov 2020 | 0.41 | 1.17 | -0.24 | -0.08 | *-0.99* |
| Jan 2020 | 1.64 | 1.68 | 0.32 | 0.31 | *0.28* |
| Jan 2019 | 1.95 | 2.16 | 0.75 | 0.68 | *0.54* |
| Jan 2017 | 1.44 | 2.35 | 0.58 | 0.35 | *-0.32* |
| Jan 2015 | 1.47 | 2.34 | 0.62 | 0.39 | *-0.24* |
| Jan 2013 | 1.56 | 2.38 | 0.38 | 0.25 | *-0.43* |
| Jan 2011 | 2.77 | 3.68 | 1.30 | 0.98 | *0.41* |
| Jan 2009 | 2.89 | 3.98 | 2.70 | 1.96 | *1.62* |

Hypothetical months **HM1** and **HM2** were constructed by reducing all three of the CANSIM series rates in paragraph 3540.05 from their values for the April 2021 calculation month by 1.00% and 2.00%, respectively. Tables 2, 3, and 4 will demonstrate why HM2 is a situation that clearly leads to inappropriate annuity factors under the current Standards.

Table 2: Nominal interest rates and inflation rates (prior to application of the selected rounding convention). All values in %.

| **Month of calculation** | **$i_{1\text{-}10}$ Current** | **$i_{10+}$ Current** | **$c_{1\text{-}10}$ Current** | **$c_{10+}$ Current** | **$i_{1\text{-}10}$ *Proposed*** | **$i_{10+}$ *Proposed*** | **$c_{1\text{-}10}$[2] *Proposed*** | **$c_{10+}$[2] *Proposed*** |
|---|---|---|---|---|---|---|---|---|
| HM2 | -0.093 | 1.443 | 71.640 | -15.349 | *0.000*[1] | *1.443* | *1.712* | *1.712* |
| HM1 | 0.906 | 2.447 | 0.453 | 2.333 | *0.906* | *2.447* | *1.703* | *1.703* |
| Apr 2021 | 1.910 | 3.457 | 1.083 | 2.000 | *1.910* | *3.457* | *1.695* | *1.695* |
| Mar 2021 | 1.586 | 3.465 | 0.795 | 2.069 | *1.586* | *3.465* | *1.645* | *1.645* |
| Feb 2021 | 1.208 | 3.059 | 0.549 | 2.030 | *1.208* | *3.059* | *1.536* | *1.536* |
| Jan 2021 | 1.221 | 2.811 | 0.574 | 1.945 | *1.221* | *2.811* | *1.487* | *1.487* |
| Nov 2020 | 1.310 | 2.455 | 0.490 | 1.862 | *1.310* | *2.455* | *1.404* | *1.404* |
| Jan 2020 | 2.537 | 2.597 | 1.308 | 1.356 | *2.537* | *2.597* | *1.340* | *1.340* |
| Jan 2019 | 2.849 | 3.168 | 1.252 | 1.455 | *2.849* | *3.168* | *1.387* | *1.387* |
| Jan 2017 | 2.335 | 3.713 | 1.068 | 2.086 | *2.335* | *3.713* | *1.747* | *1.747* |
| Jan 2015 | 2.365 | 3.683 | 1.063 | 2.012 | *2.365* | *3.683* | *1.697* | *1.697* |
| Jan 2013 | 2.456 | 3.698 | 1.293 | 2.320 | *2.456* | *3.698* | *1.978* | *1.978* |
| Jan 2011 | 3.669 | 5.041 | 1.755 | 2.613 | *3.669* | *5.041* | *2.328* | *2.328* |
| Jan 2009 | 3.391 | 5.023 | 0.908 | 1.406 | *3.391* | *5.023* | *1.241* | *1.241* |

For months prior to December 2020, the Standards define $r_{1\text{-}10}$ and $r_{10+}$ rather than $c_{1\text{-}10}$ and $c_{10+}$. The values shown in the table for $c_{1\text{-}10}$ and $c_{10+}$ for those months are $(1+ i_{1\text{-}10})/(1+ r_{1\text{-}10}) - 1$ and $(1+ i_{10+})/(1+ r_{10+}) - 1$, respectively. Hypothetical months HM1 and HM2 use the same liquidity spread as used for April 2021 calculation months.

Notes:

[1] In HM2, $i_{1\text{-}10}$ is floored at zero.

[2] For every month, $c_{1\text{-}10} = c_{10+} = \text{BEIR}$.

Table 3: CV factors for a lifetime monthly pension of $1 per year which is fully indexed to CPI during both the deferral period and payment period.

| Month of calculation | 25 years old | | | 45 years old | | |
|---|---|---|---|---|---|---|
| | **Current** | ***Proposed*** | **% chg** | **Current** | ***Proposed*** | **% chg** |
| HM2 | 5.5 | *38.5* | +606.2% | 200.9 | *35.1* | -82.5% |
| HM1 | 26.2 | *22.5* | -14.1% | 25.8 | *25.1* | -2.6% |
| Apr 2021 | 13.6 | *12.7* | -6.8% | 17.8 | *17.6* | -1.0% |
| Mar 2021 | 14.0 | *12.7* | -9.3% | 18.1 | *17.9* | -1.3% |
| Feb 2021 | 16.6 | *14.8* | -10.9% | 19.9 | *19.6* | -1.7% |
| Jan 2021 | 18.3 | *16.4* | -10.2% | 21.0 | *20.7* | -1.6% |
| Nov 2020 | 19.7 | *17.7* | -10.3% | 21.7 | *21.3* | -1.7% |
| Jan 2020 | 14.6 | *14.5* | -0.4% | 18.2 | *18.1* | -0.1% |
| Jan 2019 | 11.4 | *11.2* | -1.6% | 15.6 | *15.6* | -0.2% |
| Jan 2017 | 12.5 | *11.5* | -7.5% | 16.7 | *16.5* | -1.0% |
| Jan 2015 | 12.0 | *11.1* | -7.0% | 16.2 | *16.1* | -0.9% |
| Jan 2013 | 13.8 | *12.8* | -7.6% | 17.6 | *17.4* | -1.1% |
| Jan 2011 | 8.5 | *8.0* | -6.1% | 13.1 | *13.0* | -0.7% |
| Jan 2009 | 4.8 | *4.7* | -3.5% | 9.5 | *9.5* | -0.3% |

Table 4: CV factors for a lifetime monthly pension of $1 per year which is fully indexed during only the payment period.

| Month of calculation | 25 years old | | | 45 years old | | | 65 years old | | |
|---|---|---|---|---|---|---|---|---|---|
| | **Current** | ***Proposed*** | **% chg** | **Current** | ***Proposed*** | **% chg** | **Current** | ***Proposed*** | **% chg** |
| HM2 | 3.6 | *19.5* | +436.0% | 4.8 | *25.0* | +421.5% | 1495.2 | *31.1* | -97.9% |
| HM1 | 12.6 | *11.5* | -8.7% | 19.6 | *17.9* | -8.5% | 25.5 | *27.1* | +6.4% |
| Apr 2021 | 6.8 | *6.5* | -4.0% | 13.1 | *12.6* | -3.9% | 22.8 | *23.6* | +3.2% |
| Mar 2021 | 7.0 | *6.6* | -5.5% | 13.6 | *12.9* | -5.4% | 23.0 | *24.0* | +4.4% |
| Feb 2021 | 8.6 | *8.1* | -6.5% | 15.4 | *14.5* | -6.4% | 23.7 | *24.9* | +5.1% |
| Jan 2021 | 9.7 | *9.1* | -6.1% | 16.4 | *15.4* | -6.0% | 24.0 | *25.1* | +4.7% |
| Nov 2020 | 10.8 | *10.1* | -6.2% | 17.2 | *16.1* | -6.1% | 23.9 | *25.1* | +4.7% |
| Jan 2020 | 8.6 | *8.5* | -0.2% | 13.9 | *13.9* | -0.2% | 22.5 | *22.5* | +0.2% |
| Jan 2019 | 6.5 | *6.5* | -0.9% | 12.0 | *11.9* | -0.9% | 21.3 | *21.5* | +0.7% |
| Jan 2017 | 6.0 | *5.8* | -4.4% | 12.2 | *11.7* | -4.3% | 22.0 | *22.8* | +3.5% |
| Jan 2015 | 5.9 | *5.7* | -4.1% | 11.9 | *11.5* | -4.0% | 21.7 | *22.5* | +3.3% |
| Jan 2013 | 6.1 | *5.8* | -4.5% | 12.3 | *11.8* | -4.4% | 22.3 | *23.1* | +3.5% |
| Jan 2011 | 3.3 | *3.2* | -3.5% | 8.5 | *8.2* | -3.5% | 20.1 | *20.7* | +3.0% |
| Jan 2009 | 2.9 | *2.9* | -1.9% | 7.6 | *7.4* | -1.9% | 18.2 | *18.6* | +1.7% |

Table 5: CV factors for a lifetime monthly pension of $1 per year which is not indexed.

| Month of calculation | 25 years old | | | 45 years old | | | 65 years old | | |
|---|---|---|---|---|---|---|---|---|---|
| | **Current** | ***Proposed*** | **% chg** | **Current** | ***Proposed*** | **% chg** | **Current** | ***Proposed*** | **% chg** |
| HM2 | 15.15 | *15.01* | -0.9% | 19.67 | *19.49* | -0.9% | 24.68 | *24.50* | -0.7% |

For all other months of calculation, there is no change to the CV factors between current and proposed.

The form of these sample members' pensions is joint and 60% survivor with no guarantee period, deferred to age 65 (if applicable), spouse same age as member; mortality is unisex with 50% male and 50% female rates using the CPM2014 mortality table and the CPM-B improvement scale; a 2021 current valuation year is used for all factors. Interest rates and pension escalation rates were not rounded to their nearest 0.1% to eliminate the noise that rounding introduces.

## Appendix D: Detailed analysis of comparisons of alternatives for the inflation assumption

The DG examined several alternative approaches to deriving the inflation assumption by comparing annuity factors under those approaches to the theoretical ideal of a market-calibrated inflation expectation curve. In all cases, annuity factors were calculated using:

- nominal discount rates determined from seven-year and long-term benchmark bond yields according to the provisions of subsection 3540 effective for that month;
- joint and 60% survivor pensions, no guarantee period;
- spouses the same age as plan members;
- unisex mortality for members and spouses, blended 50% males and 50% females;
- CPM2014 mortality table and the CPM-B improvement scale and a 2021 current valuation year;
- no provision for death in the deferral period (i.e., a death benefit equal to the commuted value);
- payments monthly in arrears;
- indexation is applied monthly; and
- we ignore the one-month lag and all 0.1% rounding conventions.

With this methodology, the only variations in annuity factors considered are due to market conditions and the choice of inflation assumption.

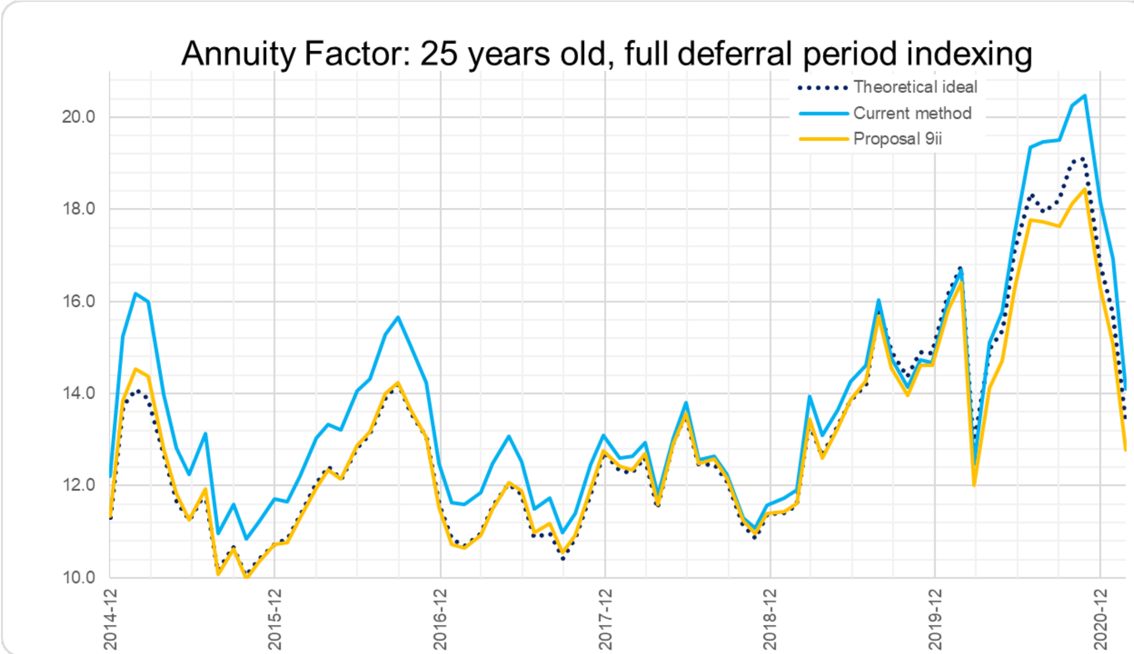
The market-calibrated inflation curve was derived from nominal and real return spot curves for GoC bonds provided by Fiera Capital for month-end dates from December 2014 through February 2021.

The spot rates were provided at quarterly intervals for a period of 40 years. The spot rates applicable beyond 40 years were assumed to be identical to the 40-year rates. The forward break-even inflation rate for each future monthly payment was derived from the real and nominal spot rates for the term closest to the payment date. That is, the rate of inflation applicable in a quarter is:

$$\left(\frac{1+i_t}{1+r_t}\right)^t \div \left(\frac{1+i_{t-1}}{1+r_{t-1}}\right)^{t-1} - 1$$

The graphs below compare annuity factors determined using:

- the current definition of $r_7$;
- the proposed definition of $r_7$; and
- the theoretical ideal of a full inflation curve.


Annuity Factor: 25 years old, full deferral period indexing
Theoretical ideal
Current method
Proposal 9ii
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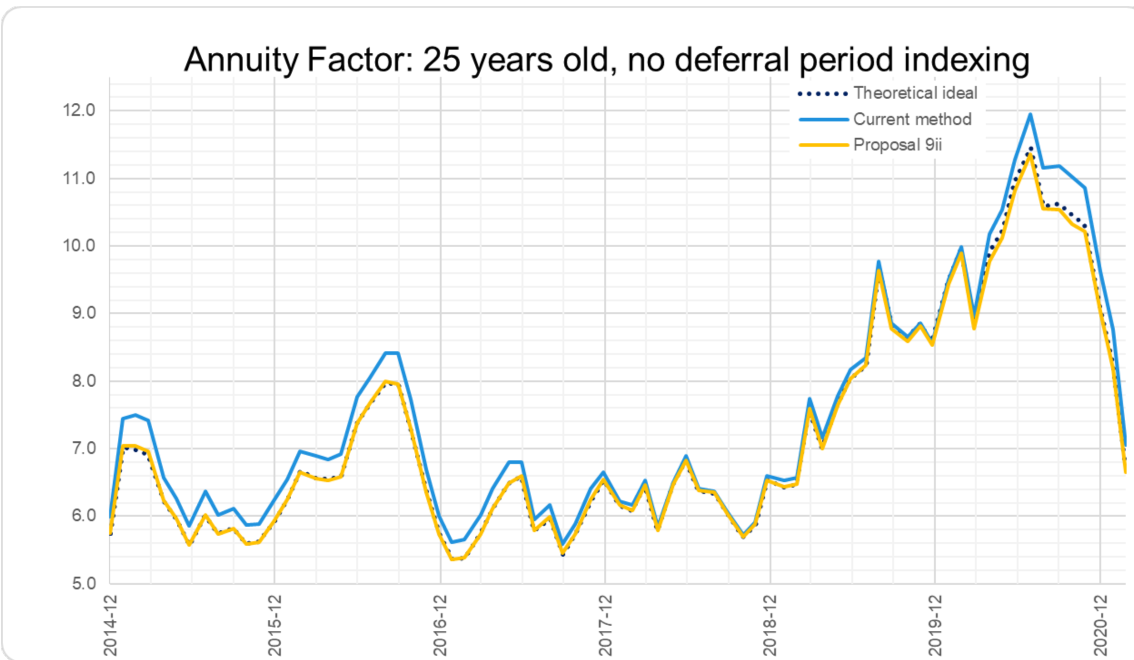
Annuity Factor: 25 years old, no deferral period indexing
Theoretical ideal
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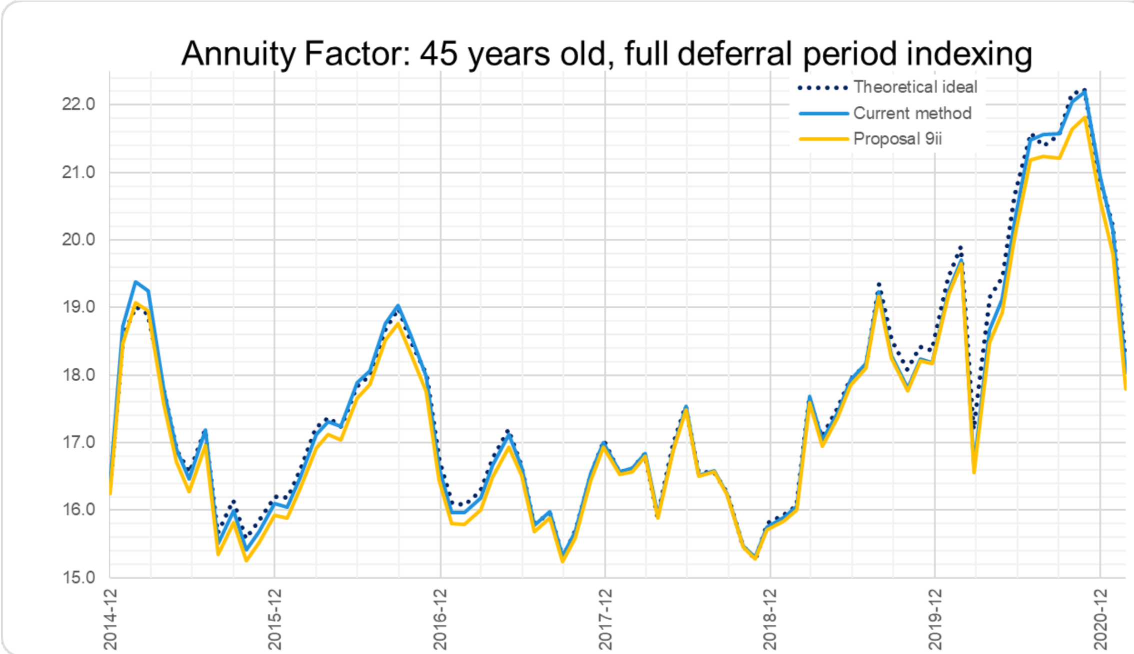
Annuity Factor: 45 years old, full deferral period indexing
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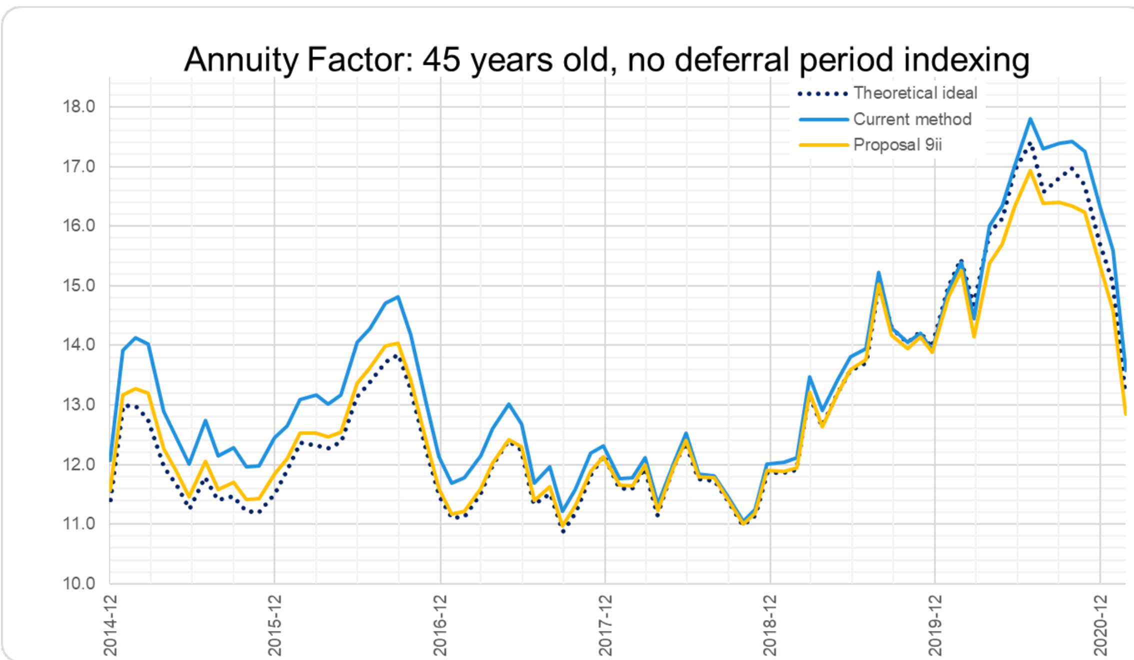
Annuity Factor: 45 years old, no deferral period indexing
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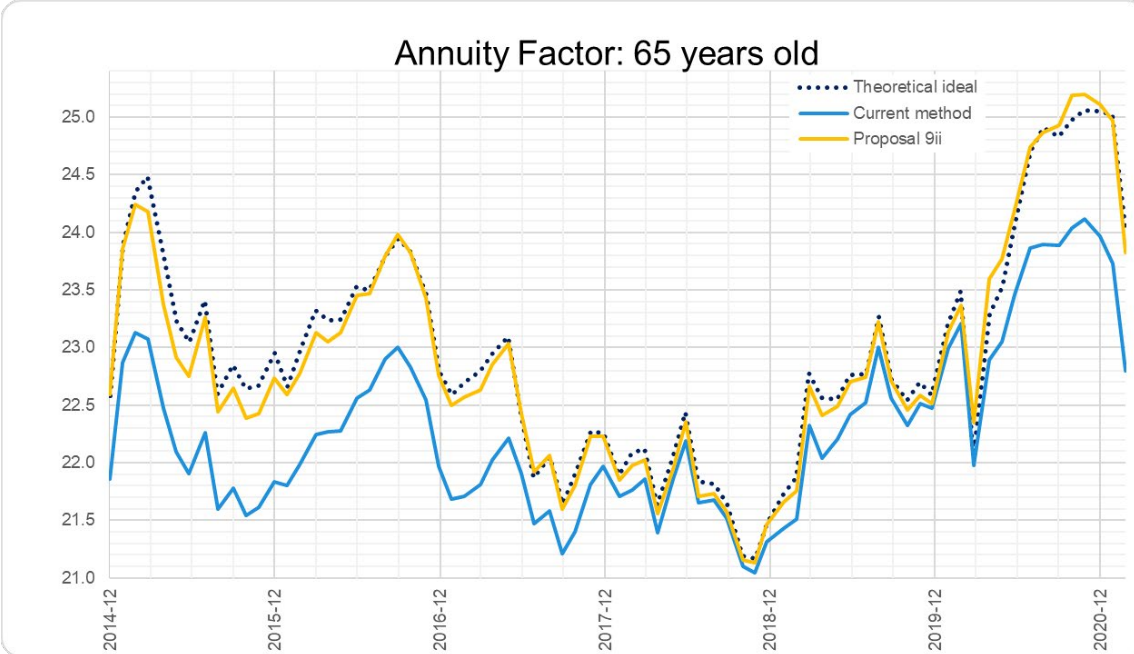


It is apparent from the graphs that the proposed definition would have tracked results using the full inflation curve more closely if it had been in effect over the 75-month period for which seven-year real return bond yield data are available than the current method. The root-mean-square error is quantified in the table below. A breakdown of this statistic into components is shown for one case (age 25, full deferral period indexing).

| **Age 25**<br>**Full deferral period indexing** | **Theoretical ideal** | **Current approach** | **Proposed approach** |
|---|---|---|---|
| (a) Average annuity factor | 13.09 | 13.79 | 12.99 |
| (b) Standard deviation of annuity factors | 2.23 | 2.34 | 2.06 |
| (c) Bias (difference of average annuity factor from theoretical ideal) | - | 0.70 | -0.10 |
| (d) Standard deviation of difference from theoretical ideal | - | 0.54 | 0.29 |
| (e) Total root-mean-square error $\sqrt{(c)^2 + (d)^2}$ | - | 0.88 | 0.31 |

In addition to the current definition of $r_7$ and the proposed definition of $r_7$, the DG considered three other variations:

1. The interpolated real yield for the term that matches the term of the Bank of Canada seven-year benchmark bond (this term varied from five years four months to seven years four months over the dates considered).
2. The real and nominal yields interpolated to a term of seven years (i.e., replacing the seven-year benchmark nominal bond yield with an interpolated yield).
3. The proposed definition of $r_7$ adjusted upward by 0.1% to reflect the leftward skew observed in the histogram in paragraph 6 of the main document.

Root-mean-square errors (RMSE) are shown in the table below for all alternatives – the lower the RMSE the better. Alternatives 1 and 2 have identical RMSEs to each other at the level of precision shown, and are higher than the proposed approach for four annuity factors out of five. Alternative 3 has a slightly lower RMSE than the proposed approach for two annuity factors out of five and a slightly higher RMSE for two annuity factors out of five. Since the proposed approach is simpler than Alternative 3, the DG considers the proposed approach to be superior.

| **Root-mean-square error** | **Current approach** | **Proposed approach** | **Alt 1&2 market data** | **Alt 3 0.1% adjustment** |
|---|---|---|---|---|
| Age 25, full deferral period indexing | 0.88 | 0.31 | 0.34 | 0.28 |
| Age 25, no deferral period indexing | 0.29 | 0.05 | 0.10 | 0.05 |
| Age 45, full deferral period indexing | 0.15 | 0.26 | 0.22 | 0.24 |
| Age 45, no deferral period indexing | 0.58 | 0.24 | 0.28 | 0.25 |
| Age 65 | 0.77 | 0.14 | 0.25 | 0.22 |

The three alternative approaches yielded poorer results than the proposed approach since inflation spot rates determined using the full curve are quite flat beyond the 10th year and so any attempt to extrapolate a pattern of forward inflation rates from the slope of short-term inflation spot rates tends to overstate the ultimate inflation rate applicable 40 or more years in the future.

## Appendix E: Reference material

In the course of their work, DG members considered data and research from a variety of public and private sources.

### Data resources

The Bank of Canada website provides extensive historical data on Government of Canada bonds, including:

- benchmark and average yields to maturity;
- the bonds chosen as benchmarks at various dates;
- forward rate curves;
- auctions of new bond issues; and
- monetary policy actions.

The U.S. Department of the Treasury website provides extensive historical data on U.S. Treasury bonds, including:

- par nominal and real yield curves;
- constant maturity yields; and
- long-term real rate averages.

The Bank of England website provides extensive historical data on United Kingdom government debt, including:

- nominal spot rates and instantaneous forward rates derived from conventional gilt prices and General Collateral repo rates;
- real spot rates and instantaneous forward rates derived from index-linked gilts; and
- inflation expectation curves derived from the differences in forward rates.

Various websites provide current and historical data on government bond yields from other countries, for example:

- https://data.oecd.org/interest/long-term-interest-rates.htm ,
- https://fred.stlouisfed.org/tags/series?t=oecd%3Byield ,
- http://www.worldgovernmentbonds.com/ ,
- https://www.icmagroup.org/Regulatory-Policy-and-Market-Practice/Secondary-Markets/market-data/global-bond-yields/

It is sometimes difficult to assemble the data in a way that illustrates how the term structure of inflation expectations has varied over time. For an innovative approach to this, see https://www.youtube.com/watch?v=obz2_Dol-Js

### Research – Low and negative interest rates

Christensen J, Rudebusch G, Schultz P. *Accounting for Low Long-Term Interest Rates: Evidence from Canada*. Federal Reserve Bank of San Francisco Working Paper Series, Working Paper 2020-35, November 2020.

https://www.frbsf.org/economic-research/files/wp2020-35.pdf

This very recent paper concludes that a drop in the equilibrium real interest rate largely accounts for the decline in Canadian interest rates. It includes analysis of the term structure and liquidity premiums for Canadian real return bonds.

Illing G. *The Limits of a Negative Interest Rate Policy (NIRP).* Credit and Capital Markets, Volume 51, Issue 4, pp 561-585.

https://www.sfm.econ.uni-muenchen.de/lehre/makro1/materialien-in-der-vorlesung/limits-of-nirp.pdf

This academic paper examines the role of paper currency and other limitations on negative interest rates. Trends in interest rates are examined in terms of the natural (or neutral) real rate of interest.

King M., Mann C. *Negative Rates – What Is the Real Limit to Cheap Money?* Citi GPS: Global Perspectives & Solutions, July 2020.

https://ir.citi.com/S%2BD4lMgjmRBaXoDaPfN2eXKf0K30fbqQmnvh%2BDm%2BZQfkI2P7TTMq9zBTKOIxXjELbGp44yMvulk%3D

This reader-friendly paper examines the responses to negative interest rates from various market participants (households, pension plans, businesses, …). It provides insights into the limitations of negative interest rates as tools of monetary policy and the real lower bound on nominal interest rates.

**Research – Breakeven inflation rates**

Cette G., De Jong M. *Breakeven Inflation Rates and Their Puzzling Correlation Relationships*. Banque de France, Document de Travail No. 367, February 2012.

https://papers.ssrn.com/sol3/papers.cfm?abstract_id=2012209

Fisher (1930) postulated that nominal bond yields were comprised of real yields and break-even inflation rates, and that these two factors are independent. While analysis of country-specific data supports this hypothesis, analysis of global data does not.

Shen P. *Liquidity Risk Premia and Breakeven Inflation Rates*. Federal Reserve Bank of Kansas City, Second Quarter 2006.

https://www.kansascityfed.org/documents/1401/2006-Liquidity%20Risk%20Premia%20and%20Breakeven%20Inflation%20Rates.pdf

This paper examines components of the US breakeven inflation rate: inflation expectations, the liquidity premium and the inflation risk premium.

Christensen I., Reid C., Dion F. *Real Return Bonds, Inflation Expectations, and the Break-Even Inflation Rate*. Bank of Canada Staff Working Paper 2004-43, November 2004.

https://www.bankofcanada.ca/2004/11/working-paper-2004-43/

This paper compares Canadian breakeven inflation rates to inflation expectations and finds that, between 1992 and 2003, breakeven inflation rates were higher and more variable than survey measures of inflation.

Imakubo K, Nkajima J. *What do negative inflation risk premia tell us?* Bank of Japan Research LAB No. 15-E-4, July 9, 2015.

https://www.boj.or.jp/en/research/wps_rev/lab/lab15e04.htm/

Japan has had periods of positive and negative inflation risk premia. This short article relates these periods to perceived inflation and deflation risks.

Hiraki K., Hirata W. *Market-based Long-term Inflation Expectations in Japan: A Refinement on Breakeven Inflation Rates*. Bank of Japan Working Paper Series No 20-E-5.

https://www.boj.or.jp/en/research/wps_rev/wps_2020/wp20e05.htm/

Since 2013, Japanese real return bonds have included a deflation protection feature that prevents the maturity value of a bond from falling below the nominal par value at issue. This is an important reason for differences between inflation expectations and breakeven rates. The paper applies bond pricing models to estimate the components of the breakeven rate, including an approach to liquidity premia suited to the Japanese situation.