DRAFT, For Discussion Purposes
Joint P&C/Health Bond Factors Analysis Work Group Report to
NAIC "Joint Health RBC and P/C RBC Drafting Group"

1. Introduction

This material summarizes the status of analysis being done by the American Academy of Actuaries' Joint P&C/Health Bond Factors Analysis Work Group (PCHWG), for the NAIC "Joint Health RBC and P/C RBC Drafting Group" (NAIC Drafting Group). The analysis deals with certain aspects of risk-based capital (RBC) factors related to default risk on fixed income securities.

This material is preliminary. The PCHWG is providing this material to the NAIC Drafting Group at this point to allow discussion of relevant issues, recognizing that our work will evolve for a variety of reasons, including the input out of discussions with the NAIC Drafting Group.

The material may be revised, perhaps materially, by the PCHWG based on further discussion and analysis.

2. Scope

In July 2017, PC/H Committees provided a report to the NAIC Investment Risk-Based Capital (E) Working Group (IRBC).

In that report, the PC/H Committees offered to examine the following:

- Maturity—including appropriateness of the Life Representative Portfolio and the Time Horizon assumptions for P&C and health companies.
- Adjustment for Below-Investment-Grade Bonds—use of 50 percent adjustment.
- Tax treatment—why the RBC view of the tax situation on default risk might be different for P&C and health companies than for life companies.

In addition, at the December 13, 2017, Bond Drafting Group conference call, the PCHWG and the Bond Drafting Group members raised the issue of the extent to which the C1WG model ("Life Model") could be used for shorter time horizons. PCHWG agreed to do further analysis of the applicability of the Life Model to shorter time horizons, and to the P&C/Health RBC formulas more generally.

In this material we address the following issues:

1) Applicability of the Life Model for use with a time horizon shorter than 10 years.

2) Quantitative Implications of applying the Life Model economic scenarios to alternative time horizons and representative portfolios.

3) General considerations in setting assumptions and safety levels for Life/P&C/Health companies.

4) Setting time horizon and representative portfolio assumptions for P&C and Health companies.

5) Applicability of Life Model to P&C and Health companies, with appropriate adjustment.

6) Accounting difference for below-investment grade bonds—not included in this draft; verbal update can be provided.

7) Tax treatment differences.

The Key American Academy of Actuaries documents that we draw from in this report are:

- August 3, 2015, C1WG Report—Model construction and Development of RBC Factors for Fixed Income Securities for the NAIC Life Risk-Based Capital Formula ("2015 C1WG Report").

- June 8, 2017, C1 letter captioned: Updated Recommendation of Corporate Bond Risk-Based Capital (RBC) Factors.

- October 10, 2017 C1WG letter captioned: Updated Recommendation of Corporate Bond Risk-Based Capital (RBC) Factors. ("2017 C1WG Letter").

- July 24, 2017 PC/H Committees letter, response to June 8, 2017 C1 Work Group Updated Recommendation of Corporate Bond Risk-Based Capital Factors ("PCHWG 2017 Letter")

Focus on P&C in this report

The PCHWG work is more developed for P&C than for health. We will provide a verbal report on the status our health analysis on the next conference call, and we will develop the health-related aspects of our analysis further in updates to this report.

3. Applicability of Life Model to Alternative Time Horizons and Alternative Representative Portfolios

Background

We refer to the model described in the 2015 C1WG Report, with the changes in the 2017 C1WG Letter as the "Life Model."

The C1WG report (page 12) introduces the modeling approach and says: "The C1 capital represents the [present value] amount of funds needed such that this amount is sufficient to cover losses in excess of those anticipated in policy reserves that could occur within the bond portfolio over the specified time horizon within the stated confidence level."

This Life Model input includes:

- Expected annual default rates (separately for each rating class),[1]
- Expected recovery rates (for all rating classes combined),
- Adjustments to those expected default and recovery rates based on variable economic conditions, good or bad (separately for each rating class for default rates and for all rating classes combined for recovery rates), and
- Representative portfolio, the number of issuers by size[2] band (18 size bands).[3] The Life Model uses the same representative portfolio for each rating class.

For each rating class, the Life Model calculates the cumulative default amount, net of other cash flows, at each year-end within the specified 10-year time horizon, for each of 10,000 trials. For each rating class, the model identifies the year-end with the greatest present value cumulative default amount (worst year-end)[4] for each trial. For each rating class, the C1WG base factors are approximately equal to the 96th percentile of those worst year-end values.[5]

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[1] The expected annual default rates, also called annual spot rates in the 2015 C1WG Report, is derived for age-n by comparing cumulative default rates at age-n and age-n-1. The "spot rate" for rating class "X" and age "n" means the probability of default in n-th year after the valuation date, at which time the bond had rating "X."

[2] Issuer-size, or size, means the book adjusted carrying value (BACV) for that issuer.

[3] See the 2015 C1WG Report, Appendix D, for a description of how the Representative Portfolio is derived. Subject to the greater detail in the 2015 C1WG Report, Appendix D, we briefly summarize the Representative Portfolio as being the issuer-size distribution of bonds for Rating Classes 1 and 2, in actual life company portfolios, for companies with company size (measured by total company BACV) around the median company size.

[4] The Life Model calculates results gross and net of default experience anticipated in policy reserves. For purposes of this analysis we consider the results gross of policy reserves because there are no such reserves for P&C or Health.

[5] The C1 base factors are determined by solving for the percentile of worst year-end values, which, when applied by Rating Class as risk charges to modeled actual life company portfolios, reproduces the sum of the individual company C1 amounts at a 96th percentile confidence level. The risk charge percentile that met that criterion for each rating class was slightly less than the 96th percentile. The risk charge percentile that met that criterion for each rating class was slightly less than the 96th percentile.

Separately, the C1WG constructed portfolio adjustment (PA) factors that increase/decrease a company's base C1 amount.[6] Generally, the PA increases/decreases the base C1 amount depending on whether a company's bond portfolio has less/more issuers than the number in the representative portfolio. The portfolio adjustment factor for a company with the same number of bonds as contained in the representative portfolio is close to 1.0.[7]

The time horizon used in the C1 results is 10 years. The target safety margin is the 96th percentile. The 10-year time horizon and the 96th percentile were prescribed by regulators.[8]

The Life Model does not explicitly model bond maturities. Essentially, losses from defaults are modeled relative to an assumed mix (quality at the valuation date and size distribution) of bonds that remains constant throughout the horizon. Hypothetically, the analysis assumes that any maturing bonds are replaced by bonds of the same Rating Class.[9] Further, the model also assumes no residual credit risk at the end of 10 years from bonds remaining in a portfolio.

Application to P&C/Health

In Appendix 1 of this material, we examine the default rates, recovery rates and economic conditions analysis used in the Life Model. Based on our work to date, we observe no reasons why those features of the Life Model cannot be used for Time Horizons of 10 years or less.

That said, the results of the Life Model depend on the Representative Portfolio and the Portfolio Adjustment Factors. Using the Life Model to another type of business, with a 10-year or other Time Horizon, requires consideration on the appropriateness of the Representative Portfolio used in the Life Model.

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[6] The PA was developed using each life company's actual bond portfolio. The PA factor scale increases or decreases the base C1 Amount of each company's portfolio to provide a best fit to the aggregate of the matching portfolios based on the target portfolio C1 for each company.

[7] But not exactly 1.0 due to variations of size distribution from the representative portfolio by life companies that were used to fit the PA scale.

[8] We understand that this is the safety level that was used to calibrate the RBC formula when it was implemented in 1994.

[9] The implicit assumption is one of the following: (1) there is no variation in default rates by bond maturity, or (2) the distribution of bonds by maturity in the Moody's data is the same as the distribution of bonds by maturity in the Representative Portfolio, or (3) the effect of any deviations from (1) and (2) are small enough that they do not need to be considered.

4. Application of Life Model with Alternative Time Horizons and Representative Portfolios

In this section, we test the effect on the indicated risk charges from the Life Model by using alternative assumptions. In Section 6, below, we describe the issues related to selection of assumptions regarding time horizon and the differences in representative portfolios between types of business.

Exhibits 1-3 attached show the implications of applying the Life Model to alternative time horizons and representative portfolios.

- We consider time horizons of 10, 6, 5, 4, and 1 years, as those are candidates for consideration for P&C and health business.

- We consider representative portfolios based on P&C companies and health companies.

Our baseline is the result of the Life Model at a 96 percent confidence level[10] over a 10-year time horizon with the life representative portfolio, zero federal taxes, and zero risk premium offset for statutory policy reserves. Note that the results in our exhibits do not adjust for the accounting difference for below investment grade bonds.

Results vary by bond rating class, and, for convenience, we express the results below as simple and weighted averages of the 19 rating classes.

Our observations are the following:

- **Time Horizon** (Exhibit 1)——On average, with all other assumptions unchanged, the indicated risk charges decrease by 30 percent if the time horizon is reduced from 10 years to 6 years, 39 percent if the time horizon is reduced to 5 years, 50 percent if the time horizon is reduced to 4 years, and 89 percent if the time horizon is reduced to 1 year.
  An important conclusion is that the decision of time horizon is a critical assumption in determining the risk charge.

  Representative Portfolio (Exhibit 2)——The P&C representative portfolio and the health representative portfolio have fewer issuers and a somewhat wider spread of bond sizes, compared to the life representative portfolio. As a result, the indicated risk charges would be higher for P&C and health, compared to life, with all assumptions other than representative portfolio unchanged. For P&C, the effect of P&C representative portfolio compared to the life representative ortfolio is an increase of 15 percent using the 10-year time horizon or 12 percent using a 4-year time horizon. Also, the effect of the differences in representative portfolio are at least partially

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[10] We use 96th percentile for this comparison. The final life C1 base factors use a confidence level of 95.66 percentile as described earlier.

offset by the portfolio adjustment factors, for P&C, to an extent we plan to determine. We have not yet examined the extent to which the portfolio adjustment factors offset differences in representative portfolio, especially if Life and P&C use different time horizons.[11]

- **Time Horizon and Average Annual Components of Risk Charges** (Exhibit 3)—It is not surprising, as shown in Exhibit 1, that the risk over a shorter time horizon would be lower than the risk over the longer ime horizon. In Exhibit 3 we calculate loss at the "per year" components of the risk by time horizon. We take the risk charges from Exhibit 1 and calculate the n-th root of 1+ risk charge for each rating class and each time horizon.[12]

  We see that, generally, the annualized risk charges are higher for shorter time horizons than for longer time horizons. This is not surprising. It is to be expected as 96th percentile "safe" trials will include some in which the longer time horizon has more opportunity for early year good experience to offset later year bad experience.

  Thus, we understand the results in Exhibit 1 to mean that the shorter time horizon overall has lower risk than a longer time horizon, reflecting a benefit from including fewer years of defaults offset somewhat by higher risk per year within that time horizon.

- **Effect of Asset Maturity**—Asset maturity is not a feature of the Life Model. The Life Model default rates assume that either (a) default risk and recovery rates do not depend on maturity, only on rating class and age or (b) the distribution of maturities in the Moody's default risk data are consistent with the distribution of maturities in the representative portfolio.

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[11] There is no health portfolio adjustment in the current Health RBC Formula.
[12] For example, the 10th power of the 1+10-year annual risk charges in Exhibit 3 equals 1+ the 10-year charge in Exhibit 1.

5. General Considerations in Assumptions and Safety Levels for Life/P&C/Health

Editing Note: This somewhat abstract discussion may need elaboration with further examples. Relevant examples may emerge from our discussions with the NAIC Drafting Group.

In setting the safety levels and risk factors, consistency is typically considered, especially when, as is the case for RBC, there is no prescribed target safety level for the overall formula. In the context of RBC calibration, consistency can mean:

- Consistent with the risks inherent in the type of business (life/health/P&C)
- Consistent with other risk factors within the type of business[13]
- Consistent with related risks in RBC Formulas for other types of business

We observe that consistency in factors is usually not the same as using the same factors for different types of business. For example, the risk premium mechanism in the Life Model reflects a feature of life insurance statutory reserve requirements that do not apply to P&C or health.

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[13] There are inconsistencies within lines of business.

6. Review of Time Horizon and Representative Portfolio for P&C and Health

Time Horizon

Time Horizon Selection in Life Model

The Life Model is calibrated so that the C1 capital represents the amount of funds needed such that this amount is sufficient to cover losses that could occur within the bond portfolio over the specified time horizon within the stated confidence level. As discussed in the 2015 C1WG Report (p26), the C1WG provided discussion regarding the time horizon selection of ten years. The C1WG identified two perspectives on the choice of a time horizon:

1) Duration of liabilities
2) Length of credit cycle[14]

As was the case in past calibrations, the time horizon used in the C1 results is 10 years. The target safety margin is the 96th percentile. The 10-year time horizon and the 96th percentile were prescribed by regulators.[15]

Time Horizon Selection for P&C

The P&C RBC Formula is calibrated to a "runoff" time horizon for underwriting (UW) risk, the largest of the P&C risks. Reserve risk measures the potential adverse development over the period until all claims are settled. Premium risk measures the potential adverse results of a single accident year, when claims are fully paid. The P&C liability average runoff time is about 4 years.[16,17]

Similarly, a consideration of the runoff of liabilities is useful when determining an appropriate time horizon for calibrating the risk charges for bond factors. The reasons for using the liability runoff time horizon include:

- Using the runoff basis for default risk time horizon would be consistent with the other main elements of the P&C RBC formula.

- Using a time horizon longer than the runoff of liabilities implies that the P&C company needs to provide for corporate bond default risk even though the company no longer has any liabilities.

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[14] 2015 C1WG Report, p26.

[15] 2015 C1WG Report, p6, also notes that if the Time Horizon were changed then the safety level might also need to be revisited.

[16] The average duration of liabilities for loss & LAE reserves and unearned premium reserves from available 2016 annual statement data.

[17] An average runoff time of 4 years means the liability decreases with payments over a period that averages 4 years. For example, payments for years 1 – 7 might be 0%, 10%, 20%, 30%, 20%, 10%, 0%, respectively. The risk charge calculation implements this 4-year average time horizon might be to calculate the average of risk charges based on time horizons from 1 year to 7 years, weighted by the payment pattern analogous to the illustration here. For simplicity we describe the time horizon as if the weighted average equaled the 4-year time horizon risk charge.

Time Horizons—Other Calibration Perspectives

Duration of assets, average holding period and credit cycle have also been discussed as criteria to consider in selecting a time horizon. We have the following comments on those possible Time Horizon criteria.

Duration of Assets and Average Holding Period

Selecting a time horizon based on the duration of assets, if it differs significantly from the liability duration would not be correct. When the asset matures, the asset would need to be replaced. Therefore, the default risk for the replacement asset should be considered, but that would not be the case if the time horizon covered only the period for the original asset.

The same is the case for using average holding period as time horizon.

Length of Credit Cycle

Length of credit cycle is one consideration noted by C1WG in support of selecting the 10 – year life time horizon C1WG. C1WG observes:[18]

- From the perspective that the time horizon is equated with the average length of a business credit cycle, the time horizon is independent of the products sold by the company;

- Current market conditions are not as relevant if the time horizon is set to be through the credit cycle. [Implying that if time horizon was not set to the credit cycle, then an adjustment may need to be made depending on where we are in the credit cycle.]; and

- The duration of the credit cycle is approximately equal to duration of assets for life companies.

The implications of these three considerations, with respect to P&C RBC calibrations, are the following:

- Being independent of the company products is not necessarily an advantage when the products are as different as those among life and P&C companies.

- The order in which good and bad economic conditions arise influences the default risk that a company will experience. Whether the time horizon is equal to or shorter than the credit cycle, the economic conditions will include the appropriate number and ordering of economic conditions over the selected time horizon.

  To the extent that economic conditions at the valuation date are favorable or unfavorable, there is an effect regardless of time horizon. That said, a similar problem arises for the UW cycle for P&C. The RBC Formula makes no adjustment because of

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[18] 2015 C1WG Report, pp26 and 95.

practical timing issues[19] and because of the uncertainty in interpreting whether conditions are going to change after the valuation date.

- It was convenient for the life calibration that asset duration and credit cycle are similar, but that is not the case for P&C.

Representative Portfolio

Regarding the representative portfolio, we observe that the typical P&C company portfolio has approximately 500 issuers [and the typical health company has approximately 300 issuers], compared to over 800 for the typical life Company on a dollar weighted basis.

Given the representative portfolio differences, even if all else were the same for Life and P&C/health companies (e.g., the same time horizon), the average bond default risk for P&C [and health] companies, should be higher than the average bond default risk factor for life companies. In Exhibit 2, discussed above, we showed the sensitivity of indicated risk charges to the differences in representative portfolio.

Portfolio Adjustment Factors as Offset to Differences in Representative Portfolio

The life portfolio adjustment factors applied to a company with the same number of bonds as contained in the representative portfolio is approximately 1.0. The typical P&C company, with fewer than 800 bonds, would have a portfolio adjustment factor greater than 1.0. This effect of the portfolio adjustment factors might largely offset the differences in representative portfolio between life and P&C companies. Note that there is no PA in the current health RBC formula.

Testing

We have not yet examined the extent to which the portfolio adjustment factors offset differences in Representative Portfolio, especially if life and P&C use different time horizons.

One option we intend to explore is whether a satisfactory safety level is achieved for P&C using risk factors with the life representative portfolio but P&C time horizon and life portfolio adjustment factors (with no adjustments).

If the test is not satisfactory then further work is necessary to adjust the risk charge and, perhaps, also the portfolio adjustment factors.

Time Horizon Selection for Health

The selection of time horizon for health has many aspects that are the same as P&C, but there are differences. We have not investigated the impact of the differences in this report.

We will provide a verbal report on the status our health analysis at the next conference call, and we will develop the health-related aspects of our analysis in further updates to this report.

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[19] Reflecting current conditions in the RBC Formula requires changing RBC formula parameters late in the year in which the formula was used. This is problematic for company capital planning and for the software firms distributing RBC tools to companies.

7. Accounting difference for Below-Investment Grade Bonds

[Progress to be discussed in future versions of this Report.]

8. Tax Treatment Differences

The original factors for P&C, health, and life were identical, except for the adjustment for below-investment-grade bonds. Thus, life, P&C, and health factors both considered taxes in the same way. The NAIC IRBC Working Group has two options:

1. Maintain consistency across life, P&C, and health——Since life companies are on a post-tax basis, this would mean that the factors used for P&C and health would be on a post-tax basis as well.
2. Maintain consistency between the various components of the P&C (and, separately the health) RBC formula. Other components of the P&C RBC formula (and health RBC formula) are on a pre-tax basis. Thus, this would mean that the P&C and health factors would be on a pre-tax basis.

We plan to provide factors both on a pre-tax and post-tax basis, and either can be used depending on the decision made by the IRBC Working Group on this issue.

9. Appendix 1–Suitability of C1WG 10-Year Time Horizon Model to Shorter Time Horizons

If it is determined that the time horizon should be consistent with the duration of liabilities for P&C and health, the time horizon would need to be shortened (as discussed earlier). This section details our analysis and conclusions regarding the applicability of the Life Model to time horizons of less than 10 years. The relevant features of the Life Model are the following:

- Baseline default rates (by bond rating class and year since rating) - C1WG Appendix A
- Recovery rates, Given Bond Default - C1WG Appendix B
- Economic cycle effect on baseline default rates and recovery rates - C1WG Appendix C

Our sources include:

- 2015 C1WG Report
- Life Model provided by Nancy Bennett——Spreadsheet
- Further explanation of the model from Jerry Holman, Life C1WG co-chair
- C1WG October 10, 2017 "Updated Recommendation of Corporate Bond Risk-Based Capital (RBC) Factors" [related to portfolio adjustment Factor]

Our discussion addresses the features potentially most relevant to the time horizon issue, and is not a complete description of the Model.

Baseline Default Rates——C1WG Appendix A
The baseline default rate element of the model is described in Appendix A of the 2015 C1WG Report.

Life Method
Determination of the baseline default rate element of the model considers the following:

- Moody's provides issuer-weighted average cumulative default rates (from 1983-2012), by rating class over investment horizons (ages 1 – 20).[20]
- The C1WG analysis uses only the data for investment horizons (ages[21]) 1 – 10, and smooths that raw data to ensure the patterns are appropriate, notwithstanding anomalous data points due to low credibility or other factors.

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[20] This data is organized by cohort date, rather than issue date. As such, it is not affected by changes in rating class over time.

[21] Age, sometimes called 'years' or 'years of experience' means the number of years from the date at which the bond rating was last determined, e.g., rating class at the annual statement date, when applied in the RBC formula.

- Finally, C1WG derives annual spot rates for age-n by comparing cumulative default rates at age-n and age-n-1. The "spot rate" for rating class "X" and age "n" means the probability of default in n-th year after the valuation date, at which time the bond had rating "X."
- The Life Model has no adjustment for bond maturity. Maturity is not a feature of the Life Model. The model default rates assume that either (a) default risk and recovery rates do not depend on maturity, only on rating class and age or (b) the distribution of maturities in the Moody's default risk data are consistent with the distribution of maturities in the representative portfolio

Health/P&C Approach

In applying the model using a time horizon of n years, where n is less than 10, the applicability of the smoothing used by C1WG is one issue to consider. In this regard, we have two choices:

A. Use the first n ages of annual spot rates from the model, or
B. Create a new table with n ages of smoothed spot rates that have been derived by smoothing only the first n ages of the Moody's cumulative default rates.

We choose alternative A for the following reasons:

1. This ensures consistency among default rates that might be applied to different time horizons, e.g., 5 years for P&C, ~1-5 years for health and 10 years for life.
2. Using a different number of years in smoothing would produce somewhat different results, but the shorter period smoothing is not necessarily more reflective of future experience (i.e., "more correct for the first n-years") than the result of smoothing the 10-year period.

In other respects, the bond default rates as applied in the model are appropriate for time horizons shorter than 10 years.

Thus, the baseline default rates as applied in the model are appropriate for time horizons shorter than 10 years.

Recovery Rates—C1WG Appendix B

The recovery rate element of the Model is described in Appendix B of the 2015 C1WG Report.

Life Model

The model uses proprietary Standard & Poor's (S&P) recovery data by calendar year to develop recovery rates typical of the entire economic cycle. The model uses the same baseline values for all the rating classes and at all ages.

P&C/Health

The model values are independent of age, and the long-term average is relevant to any time horizon shorter than 10 years.

Thus, the recovery rates as applied in the model are appropriate for time horizons shorter than 10 years.

Economic Cycle Effect on Baseline Default and Recovery Rates - C1WG Appendix C

Appendix C of the 2015 C1WG Report describes how the model determines the C1 risk charge by stochastically simulating how the default and recovery rates might vary, around the baseline levels, from year to year as economic conditions change.

Life Model

The default rates and recovery rates, determined as described above, represent long term averages over various economic conditions. To reflect variations from year-to-year due to varying economic conditions, the model produces simulations of economic conditions for each year in the time horizon. The C1 factors were developed from running 10,000 economic simulations. The model uses a four-state representation of economic conditions with the following four states:

1) Continued contraction
2) Contraction
3) Expansion
4) Continued expansion

The C1WG developed a 4-state conditional transition probability distribution (e.g., given a year of expansion, what is the probability of continued expansion). The C1WG uses more than 30 years of economic condition data to derive those transition probabilities.

For each year, in each simulation, the model adjusts the baseline default rates and the baseline recovery rates to reflect the simulated economic condition. For default rates on bonds with ratings lower than A, the model uses all four economic condition states. For default rates on bonds rated A and higher and for recovery rates on all bonds, the C1WG consolidates the 4-state transition probabilities into 2-state transition probabilities (contraction/expansion only regardless of prior year economic condition). These are cases where the C1WG believes the 2-state approach is more appropriate.

Variation by Age

Using the 1983-2012 Moody's cohort default data and the year-to-year classification by economic condition, C1WG determines indicated default rate relativities to adjust the base default rates, up or down, to reflect the applicable economic condition. The C1WG refers to these adjustments as Economic Scalars. The economic scalars vary widely and counter-intuitively by age, so the C1WG calculates and uses all-age average economic scalars, called leveled economic scalars, for each bond rating and for each economic condition.

For recovery rates, "we utilize the proprietary calendar year S&P recovery data and then assign it to the expansion and contraction years to derive recovery rates varying by the two

economic states"[22]. The C1WG uses the average relativity for all for all ten ages combined so recovery rate relativities do not vary by age.

P&C/Health

In applying the model with a shorter time horizon, e.g., 5 years, we note the following:

- For a five-year model, we could calculate leveled economic scalers over 5 years, rather than 10 years, but for the reasons described with respect to smoothing of baseline default factors, we believe using the 10-year average model values is preferable.
- As the n-year model uses only n years, it is selecting the appropriate proportion of good outcomes and bad outcomes within that n-year horizon. Therefore, a five-year horizon from the 5-year model is as good a representation of 5-year outcomes as is the case for ten-year outcomes.
- Five-year results might include more extreme cumulative default results than ten-year results, e.g., 5 good years vs. 10 good years or 5 bad years vs. 10 bad years, as there is less chance of good offsetting bad in a shorter time horizon. However, that would be appropriate for a 5-year time horizon risk charge.

Thus, the economic cycle features of the model are appropriate for time horizons shorter than 10 years.

Conclusion

We conclude that the C1WG ten-year bond risk model (model, or Life Model) can be adapted to use a time horizon shorter than 10 years without any adjustment to:

- Baseline default rates
- Recovery rates, given bond default
- Economic Cycle effect on baseline default rates and recovery rates

This analysis does not consider issues related to the representative portfolio or portfolio adjustment factors. This analysis does not consider how to select the appropriate time horizon or percentile safety level.

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[22] 2015 C1WG Report, p55.

Exhibit 1

Effect of Changes in Time Horizon
Life Model/Life Representative Portfolio[23]

(1)	(2)	(3)	(4)	(5)	(6)	(7)		(10)	(11)	(12)	(13)	(14)	(15)
Rating Class/ Time Horizon	Current P&C	C1WG Model/Life RP/Various Time Horizons						Rating Class/ Time Horizon	% Reduction in Risk Charge Indication with Time Horizon (Life RP)				
		10	6	5	4	1			10	6	5	4	1
Aaa	0.30%	0.34%	0.25%	0.21%	0.14%	0.00%		Aaa	Base	-26%	-40%	-58%	-100%
Aa1	0.30%	0.53%	0.40%	0.35%	0.26%	0.00%		Aa1	Base	-24%	-34%	-50%	-100%
Aa2	0.30%	0.76%	0.59%	0.53%	0.42%	0.01%		Aa2	Base	-23%	-30%	-44%	-99%
Aa3	0.30%	1.05%	0.81%	0.74%	0.59%	0.06%		Aa3	Base	-23%	-29%	-44%	-94%
A1	0.30%	1.41%	1.04%	0.95%	0.76%	0.12%		A1	Base	-27%	-33%	-46%	-91%
A2	0.30%	1.84%	1.25%	1.12%	0.93%	0.19%		A2	Base	-32%	-39%	-50%	-90%
A3	0.30%	2.29%	1.52%	1.32%	1.09%	0.26%		A3	Base	-34%	-42%	-52%	-89%
Baa1	1.00%	2.78%	1.82%	1.52%	1.27%	0.35%		Baa1	Base	-34%	-45%	-54%	-87%
Baa2	1.00%	3.43%	2.20%	1.82%	1.49%	0.45%		Baa2	Base	-36%	-47%	-57%	-87%
Baa3	1.00%	4.21%	2.70%	2.22%	1.80%	0.56%		Baa3	Base	-36%	-47%	-57%	-87%
Ba1	2.00%	9.35%	6.60%	5.69%	4.71%	1.05%		Ba1	Base	-29%	-39%	-50%	-89%
Ba2	2.00%	12.23%	8.75%	7.55%	6.13%	1.39%		Ba2	Base	-28%	-38%	-50%	-89%
Ba3	2.00%	16.41%	11.98%	10.31%	8.50%	1.92%		Ba3	Base	-27%	-37%	-48%	-88%
B1	4.50%	20.96%	15.08%	13.03%	10.79%	2.29%		B1	Base	-28%	-38%	-49%	-89%
B2	4.50%	29.29%	21.11%	18.59%	15.58%	3.41%		B2	Base	-28%	-37%	-47%	-88%
B3	4.50%	41.07%	29.94%	26.70%	22.72%	5.37%		B3	Base	-27%	-35%	-45%	-87%
Caa1	10.00%	57.18%	41.70%	38.03%	32.96%	10.12%		Caa1	Base	-27%	-33%	-42%	-82%
Caa2	10.00%	71.95%	54.11%	50.25%	44.38%	17.41%		Caa2	Base	-25%	-30%	-38%	-76%
Caa3	10.00%	76.90%	62.01%	57.72%	52.33%	30.64%		Caa3	Base	-19%	-25%	-32%	-60%
Average	**2.87%**	**18.63%**	**13.89%**	**12.56%**	**10.89%**	**3.98%**		**Average**		**-28%**	**-37%**	**-48%**	**-88%**
Wtd Avg	**0.79%**	**3.41%**	**2.35%**	**2.02%**	**1.67%**	**0.45%**		**Wtd Avg**		**-31%**	**-41%**	**-52%**	**-91%**

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[23] The factors shown are the 96th percent confidence interval factors produced by the C1WG bond model adjusted to a 95.65 percent confidence interval using the same adjustments used by the C1WG to convert their 10YR horizon factors in their October 10, 2017, C1WG letter.

The 95.65 percent percentile was determined by C1WG by solving for the percentile of worst year-end values, which, when applied by rating class as risk charges to modeled actual life company portfolios, reproduces the sum of their respective portfolio C1 amounts at a 96th percentile confidence level.

Exhibit 2

Effect of Changes in Representative Portfolio
Life Model/Life Representative Portfolio vs PC Representative Portfolio/10 Yr. and 4 Yr. Time Horizon

(1)	(2)	(3)	(4)	(6)	(7)		(8)	(9)		(10)	(11)
	Current P&C	C1WG Model/Life vs PC vs Health RP/Various Time Horizons									
Rating Class/ Time Horizon		Indicated Risk Charges					% Effect of PC RP vs Life RP			Indicated risk Charge	Health RP vs. Life RP
		Life	P&C	Life	P&C		10 v 10	4 v 4		Health RP	% Increase
No Years		10	10	4	4					10	10 v 10
Aaa	0.30%	0.34%	0.39%	0.14%	0.16%		15%	13%		0.46%	35%
Aa1	0.30%	0.53%	0.60%	0.26%	0.31%		13%	17%		0.73%	38%
Aa2	0.30%	0.76%	0.87%	0.42%	0.47%		14%	11%		1.05%	37%
Aa3	0.30%	1.05%	1.22%	0.59%	0.66%		15%	12%		1.40%	33%
A1	0.30%	1.41%	1.67%	0.76%	0.84%		18%	11%		1.84%	30%
A2	0.30%	1.84%	2.16%	0.93%	1.01%		17%	9%		2.39%	30%
A3	0.30%	2.29%	2.67%	1.09%	1.21%		17%	11%		2.94%	29%
Baa1	1.00%	2.78%	3.18%	1.27%	1.41%		14%	12%		3.63%	30%
Baa2	1.00%	3.43%	3.85%	1.49%	1.66%		12%	12%		4.52%	32%
Baa3	1.00%	4.21%	4.75%	1.80%	2.04%		13%	13%		5.84%	39%
Ba1	2.00%	9.35%	9.91%	4.71%	5.22%		6%	11%		12.29%	32%
Ba2	2.00%	12.23%	12.74%	6.13%	6.65%		4%	8%		15.15%	24%
Ba3	2.00%	16.41%	16.98%	8.50%	9.02%		4%	6%		19.72%	20%
B1	4.50%	20.96%	21.59%	10.79%	11.30%		3%	5%		24.78%	18%
B2	4.50%	29.29%	30.14%	15.58%	16.12%		3%	3%		33.42%	14%
B3	4.50%	41.07%	41.72%	22.72%	23.19%		2%	2%		45.60%	11%
Caa1	10.00%	57.18%	57.74%	32.96%	33.53%		1%	2%		61.53%	8%
Caa2	10.00%	71.95%	72.61%	44.38%	44.80%		1%	1%		76.97%	7%
Caa3	10.00%	76.90%	77.88%	52.33%	53.15%		1%	2%		81.55%	6%
Average	2.87%	18.63%	19.09%	10.89%	11.20%		9%	8%		21%	25%
Wtd Avg	0.57%	2.69%	2.94%	1.38%	1.49%		15%	12%		3%	33%

Exhibit 3

Annualized Risk Charge for Various Time Horizons
Life Model/Life Representative Portfolio /Time Horizons 10 Years to 1 Year

		Annual Risk Charges					
		Life RP					
		Time Horizons 10 Years to 1 Year					
10	6	5	4	1		10 to 4	10 to 1
0.03%	0.04%	0.04%	0.04%	0.00%			
0.05%	0.07%	0.07%	0.07%	0.00%			
0.08%	0.10%	0.11%	0.11%	0.01%			
0.10%	0.13%	0.15%	0.15%	0.06%			
0.14%	0.17%	0.19%	0.19%	0.12%			
0.18%	0.21%	0.22%	0.23%	0.19%			
0.23%	0.25%	0.26%	0.27%	0.26%			
0.27%	0.30%	0.30%	0.32%	0.35%			
0.34%	0.36%	0.36%	0.37%	0.45%			
0.41%	0.44%	0.44%	0.45%	0.56%			
0.90%	1.07%	1.11%	1.16%	1.05%			
1.16%	1.41%	1.47%	1.50%	1.39%			
1.53%	1.90%	1.98%	2.06%	1.92%			
1.92%	2.37%	2.48%	2.59%	2.29%			
2.60%	3.24%	3.47%	3.69%	3.41%			
3.50%	4.46%	4.85%	5.25%	5.37%			
4.63%	5.98%	6.66%	7.38%	10.12%			
5.57%	7.47%	8.48%	9.62%	17.41%			
5.87%	8.37%	9.54%	11.10%	30.64%			
Average 1.6%	2.0%	2.2%	2.4%	4.0%			
Wtd Avg 0.3%	0.4%	0.4%	0.4%	0.5%			