



AMERICAN ACADEMY of ACTUARIES

C1 RBC Model Construction and Development of Basic C1 Bond Factors NAIC C1 Factor Review Subgroup Discussion Document

**American Academy of Actuaries¹ C1 Work Group
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1. Background on RBC Principles

- a. The purpose of RBC is to identify weakly capitalized companies
- b. RBC calculation is based on statutory accounting principles. RBC establishes a minimum amount of capital to be held by insurers; this minimum capital protects statutory surplus from the fluctuations that reduce statutory surplus. For the C1 component, the C1 charges protect statutory surplus from losses in statutory asset value due to bond defaults, common stock depreciation, and other changes that flow through statutory surplus.
- c. RBC is calculated from three separate formulas (Life, Health, P&C)
 - Life RBC is post-tax; Health and P&C is pre-tax
 - Life insurers hold an AVR; P&C does not hold AVR
- d. RBC framework is based on separate distributions for material risk components (i.e., C0–C4 RBC components) that are aggregated to determine total capital requirements
- e. Required capital calculation assumes a going concern
- f. Required capital is an add-on to policy reserves under the assumption that policy reserves are adequate

2. Purpose of C1 Capital

C1 capital is required to protect against future *excess* asset losses. Policy reserves make provision for expected asset losses; capital makes provision for asset losses in excess of expected. Current RBC does not provide for extreme or catastrophic levels of loss.

3. Current C1 capital makes provision for the following risks:

- a. Deferral (preferred stock & hybrids) – part of the rating, so indirectly, part of C1.
- b. Credit Leverage – subordination level is part of the rating; therefore, credit leverage is part of C1.

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- c. Event Risk: very difficult to quantify. Event risk contributes to default experience and is therefore implicitly covered as part of historical default rates associated with a rating.
- d. Outstanding Issue: Tenor risk/Duration risk (i.e., does it make sense for a 5 year and a 30 year bond to have the same C1 factor?); Current C1 factor is independent of tenor; tenor risk is captured in the C3 calculation. *More discussion needed. Does default experience demonstrate connection between tenor and credit risk?*

4. Current C3 capital makes provision for the following risks:

- a. Call/Early Redemption/Prepayment
- b. Extension
- c. Disintermediation
- d. Reinvestment

5. Excluded Risks from the current Life RBC formula:

- a. Fair Value Depreciation of Debt Instruments:
RBC is based on statutory BV/amortized cost; changes in fair value of debt instruments do not flow through (i.e., are not reported) stat surplus. Since purpose of RBC is to absorb surplus changes due to asset defaults or other risk events in excess of expected, then RBC should not cover the risk of FV depreciation associated with debt instruments.
- b. Currency Risk:
Currency risk has been excluded from the current C1 factors due to complexity. Some companies may reflect currency risk in the C3 calculation. To the extent that a non-US dollar denominated securities are sold to generate cash, the C3 RBC component will capture currency risk.
- c. Liquidity Risk

6. The Calculation Engine

- a. One calculation engine is being built for bonds. Different applications of the bond engine will be developed for different asset types (e.g., AA Corporate Bonds) using the same calculation engine but with different assumptions.
- b. Other calculation engines could also be built for different asset classes (e.g., municipals, structures, RMBS/CMBS, etc.).
- c. Initially, each rating category will be analyzed separately. Subsequent analysis will likely show that rating categories can be combined in determining C1 factors.

7. Projection of Credit Losses

- a. Engine will project Losses Given Default (LGD) based on historical experience (i.e., historical experience is a predictor of future experience).

- b. Losses will be projected over a specified projection period (e.g., ten years). The current C1 bond factors were based on a ten year projection period. We will be able to analyze the impact of different projection periods on the resulting C1 factors.
- c. Initially, a structural or closed-form model will not be used, where future defaults are based on the individual characteristics of the securities. Structural models may be more sophisticated and appropriate for portfolio trading. Theoretically, the results from any type of model will be substantially similar under appropriately defined assumptions. Support for this statement will be provided in subsequent documents that compare different types of credit models.
- d. The bond engine defines the starting economic conditions for projecting losses. We tentatively decided to start with a random economic condition (e.g., recession or expansion). We discussed starting in a recession as capital conditions would be most under stress in a recession; a recession starting point might be more consistent with the spirit of RBC. We will test the impact of different starting economic conditions.
- e. Economic scenarios will be simulated over the modeling period using a U.S. expansion and contraction transition matrix

8. Definition of Loss and Assumed Protection against Loss

- a. C1 factors cover loss, where loss is defined as the net principal and accrued interest loss given default in excess of the expected LGD assumed in statutory policy reserves.
- b. The current C1 capital requirement for all assets generally provides for losses approximately the 95th percentile (*note: the level of protection assumed in RBC is a regulator choice.*)
- c. The current C1 factors establish aggregate protection for a bond portfolio at approximately the 96th percentile. The C1 bond factors are specified by NAIC designations 1-5 at the 92nd percentile. NAIC designation 6 bonds are considered at or near default and carried at market value; the C1 bond factor for NAIC 6 bonds was set equal to the factor for common stocks. The level of protection is a regulator choice. We can calculate C1 bond factors at different levels of protection (i.e., statistical safety levels).

9. Calculation of C1 Charges (current method)

The C1 capital represents the amount of funds needed such that this amount is sufficient to cover any losses in excess of those anticipated in policy reserves that could occur within the bond portfolio over the specified time horizon. In essence, the C1 capital is equivalent to pre-funding future losses in excess of expected at the calibrated level. The C1 capital charges are derived from a simulation model where the cash flows for a representative bond portfolio are projected assuming different economic scenarios.

The required capital for a given economic scenario is calculated as the amount of initial funds needed such that the accumulation of this initial amount and subsequent cash flows will not become negative at any point throughout the modeling period. There are additions and subtractions from this required capital fund:

- Additions to the capital fund include interest and tax recoveries of default loss increase the fund and an annual “risk premium” to fund future losses (i.e., the annual AVR contributions)
- Subtractions to the capital fund include net default losses and taxes paid reduce the fund.

The required capital for a given economic scenario is calculated as the present value of the net cash flows discounted at a specified interest rate. The current C1 factors assumed a 6% discount rate. The discount rate to use in updating the C1 bond factors needs further discussion.

Simulations project varying economic conditions. Default rates and recoveries vary from a baseline assumption dependent on the economic condition. Simulations with 2000 trials of 400 securities in each rating category are performed. The required capital amount for each simulation or economic scenario is divided by beginning assets to get a required capital factor. The required capital factors for each economic scenario are rank-ordered, thereby producing a distribution of required capital factors. The C1 charge for each NAIC rating designation 1-5 is set at the 92nd percentile.

An illustration of the distribution of C1 factors is included below.

10. **Key Modeling Assumptions**

(Note: these assumptions are not recommendations and can be changed. Where appropriate, the current RBC approach was the basis for the assumption.)

- a. Ten Year modeling period representing average length of time to maturity (identical to the current RBC approach for bonds, as defined in the late eighties)
- b. Expected default and expected recovery rates;
 - i. Expected default rates will initially come from Moody’s Default Studies, as was the case with the current RBC factors. Moody’s default rates are based on the rating at time of default rather than the rating at time of issue. Using default rates based on the rating at the time of default is consistent with statutory asset valuation principles. Also, the default rates are based on the number of issuers defaulting rather than the amount of debt defaulting. Other data from Standard and Poor’s and Fitch will also be reviewed.

- ii. The default rate represents expected cumulative default experience that encompasses the probability of default since the last known rating. The cumulative default rate each year is decomposed into an annual equivalent for this purpose. This cumulative default rate is used instead of an annual default rate with a transition matrix. Initially, we will not attempt to use a stochastic default algorithm.
- iii. The volatility of the default assumption (i.e., the fact that defaults in any given year will vary from the average or expected default assumption) can be reflected in a couple different ways.
 - 1. Default rate and recovery rate will vary with the economic environment (i.e., expansion or recovery)
 - 2. Using Monte Carlo techniques, a given bond is tested for default each year where the default probability varies with that year's economic environment.

When the portfolio of representative bonds is modeled or input into the calculation engine, each bond is tested for default each year where the probability of default varies with that year's economic conditions.

c. Recovery Rates

Current RBC assumes principal recovery equal to a varying percentage of the principal, where the percentage varies by the NAIC category (baseline rate varies by rating category and then subordination). In other words, the current C1 factors assume an inverse relationship between default rates and recovery rates. Additional review of recovery rates is needed. Moody's study suggests a correlation between recovery rates and subordination, but not with the bond rating.

- d. Reinvestment assumptions: If a default takes place, the principal loss amount is determined and the bond's salvage value reinvested in a like quality-asset with a maturity equal to the remaining time in the projection. (current RBC approach) If we are projecting to a fixed maturity point, we would assume the reinvested asset would mature at the end of the projection period.

e. Capital gains/losses taxes:

- i. Current C1 factors are based on the assumption that 50% of the capital loss is taken as an offset to the default loss.
- ii. New calculation engine: no tax credit being taken – ease of calculation; ultimate decision TBD.

Note that time horizon and statistical confidence level are critical assumptions both in terms of the level of required capital and the assumptions. Some assumptions may not vary much if the time horizon is only one year. Rather, the choice for certain assumptions may not affect the capital charge materially if only projecting losses over one year. Using a shorter time horizon may make the assumption setting process less

based on judgment and more transparent. The model being developed will allow the testing and analysis of different time horizons and statistical confidence levels.

11. Portfolio Construction (i.e., input for bond engine)

- a. Bond portfolio will consist of bonds issued of varying ratings, par amount, and maturities (i.e., an inforce portfolio). Initially, five bond sub-models will be developed to replicate the current C1 approach. The current C1 factors were calculated for a group of 400 bonds for each of the five NAIC designations. For the class 1 group, a mix of 25%/25%/50% was assumed for AAA/AA/A bonds, respectively. Ultimately, the number of C1 factors will be based on the results. It is likely that more than six factors will be needed, but how ratings are combined within each factor class will require further analysis.
- b. Representative securities will be modeled rather than using real securities or cusips. (TBD: how to generate the representative securities? Number of bonds in the modeled portfolio, characteristics, etc.)
- c. Base C1 factors assume all bonds are held at par value.
- d. TBD: how to determine or apply C1 factors for bonds not carried at par (either because bonds were purchased at a premium or discount, or because the bonds have been written down)?

12. AVR

- a. AVR was established to smooth out the impact of losses on surplus. AVR represents a provision for expected loss.
- b. The AVR *balance* has no bearing on the determination of required capital levels. AVR is a source of funds for required capital, but the AVR balance is not directly related to required capital.
- c. In the current C1 factor development, future contributions to the AVR are explicit assumptions in the bond model and modeled as contributions to the required capital fund. In other words, the C1 factors are lower due to the annual AVR contributions.
- d. The treatment of AVR requires further discussion.

13. Adjustments to Basic C1 Factors to consider include:

- a. Concentration
- b. Sector
- c. Portfolio size
- d. Other?

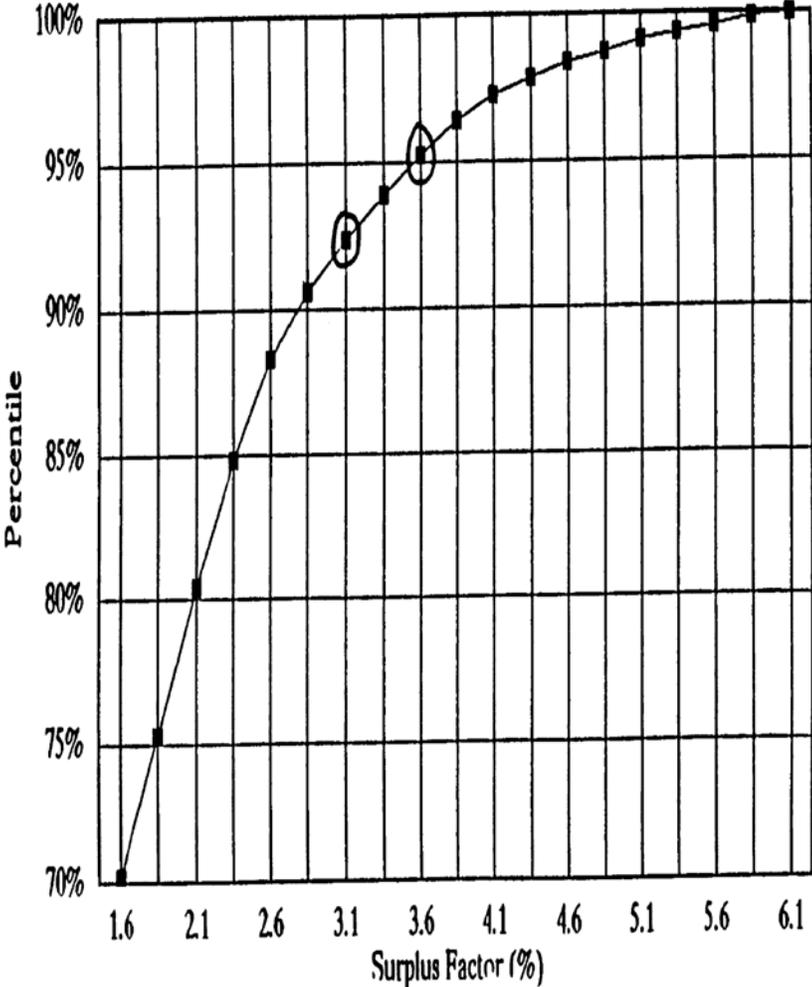
14. Other Issues: TBD

- a. How should the RBC factors for other asset classes be established, particularly with respect to the time horizon and statistical safety level?
- b. What differences should be allowed between Life, Health, and P&C?

- i. Should granularity of assets (i.e., bond classes) continue to vary between Life, Health & P&C?
 - ii. Note that the carrying value for below-investment grade assets is different in P&C blank vs. Life/Health blanks
- c. Determine/confirm if RBC calculation (and the elements of the C1 component) should be after-tax (as with LRBC) or pre-tax (as with HRBC & PCRBC).
- d. To what extent should correlation be reflected among the risks captured in the C1 component?
- e. To what degree should the interaction of assets and liabilities be recognized in establishing C1 factors?

Risk-Exposure Distribution

92nd Percentile = 3.1% 95th Percentile = 3.6%



The amount of surplus required for defaults over and above the 1.0% annual contributions to a "default reserve"; shown at the upper-tail of the risk-exposure distribution.