Draft date: 10/28/26

*2026 Fall National Meeting*
*Dallas, Texas*

**RISK-BASED CAPITAL INVESTMENT RISK AND EVALUATION (E) WORKING GROUP**
Monday, November 16, 2026
9:00 – 10:00 a.m.
Convention Center—Texas C123—Level 3

**ROLL CALL**

| | | | |
|---|---|---|---|
| Philip Barlow, Chair | District of Columbia | Tadd Wegner | Nebraska |
| Thomas Reedy, Vice Chair | California | Jennifer Li | New Hampshire |
| Wanchin Chou | Connecticut | Bob Kasinow/William B. Carmello | New York |
| Carolyn Morgan | Florida | Dale Bruggeman/Tom Botsko | Ohio |
| Matt Cheung | Illinois | Rachel Hemphill | Texas |
| Roy Eft | Indiana | Doug Stolte | Virginia |
| Carrie Mears/Kevin Clark | Iowa | Steve Drutz/Katy Bardsley | Washington |
| Fred Andersen | Minnesota | Amy Malm | Wisconsin |
| William Leung/Danielle Smith | Missouri | | |

NAIC Committee Support: Julie Gann/Maggie Chang

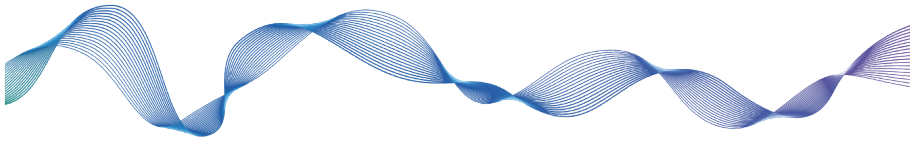
**AGENDA**

1. Consider Adoption of its Oct. 5 and June 23 Minutes — Attachment A, Attachment B
   —*Philip Barlow (DC)*

2. Receive Comments on the Summary Titled "Asset-Backed Securities Reported in 2025 Statutory Filings - Schedule D, Part 1, Section 2 - For All Types of Businesses"—*Philip Barlow (DC)* — Attachment C
   A. Alternative Credit Council (ACC) — Attachment D
   B. American Council of Life Insurers (ACLI)
   C. Pinpoint Policy Institute

3. Receive the American Academy of Actuaries (Academy) Model Document titled "Model Construction and Development of RBC C-1 CLO Factors"—*Philip Barlow (DC)* — Attachment E

4. Hear an Update from the Academy on the Collateralized Loan Obligation (CLO) Risk-Based Capital (RBC) Modeling Refinement Project — Attachment F
   —*Philip Barlow (DC)*



5. Receive Updates from the Investment Designation Analysis (E) Working Group and the Statutory Accounting Principles (E) Working Group—*Philip Barlow (DC)*

6. Discuss Any Other Matters Brought Before the Working Group —*Philip Barlow (DC)*

7. Adjournment

Draft: 7/2/26

Risk-Based Capital Investment Risk and Evaluation (E) Working Group
Virtual Meeting
June 23, 2026

The Risk-Based Capital Investment Risk and Evaluation (E) Working Group of the Capital Adequacy (E) Task Force met June 23, 2026. The following Working Group members participated: Philip Barlow, Chair (DC); Thomas Reedy, Vice Chair (CA); Wanchin Chou (CT); Carolyn Morgan (FL); Carrie Mears and Kevin Clark (IA); Matt Cheung (IL); Roy Eft (IN); Ben Slutsker (MN); William Leung and Danielle Smith (MO); Tadd Wegner (NE); Jennifer Li (NH); Bob Kasinow and William B. Carmello (NY); Dale Bruggeman (OH); Rachel Hemphill (TX); Doug Stolte and Dan Bumpus (VA); Steve Drutz and Katy Bardsley (WA); and Amy Malm (WI).

1. Adopted its May 11, May 6, April 10, and Spring National Meeting Minutes

The Working Group met May 11, May, 6, and April 10. During these meetings, it took the following action: 1) heard an update from the American Academy of Actuaries (Academy) on the collateralized loan obligation (CLO) risk-based capital (RBC) project; 2) discussed a referral to the Credit Rating Provider (E) Working Group; 3) discussed the application of regulatory judgment as described in the principles for RBC requirements; 4) heard an update from the Academy on the CLO RBC project, focusing on RBC arbitrage; 5) heard an update from the Academy on the CLO RBC project, focusing on residual tranches; 6) heard comments on the Academy's March 2 presentation regarding an update on CLO C-1 factors modeling; and 7) received comments on proposal 2025-22-IRE MOD (CLO RBC structure); exposed proposal 2026-12-IRE (CLO RBC factors).

Eft made a motion, seconded by Malm, to adopt the Working Group's May 11 (Attachment XX), May 6 (Attachment XX), April 10 (Attachment XX), and March 23 minutes *(see NAIC Proceedings – Spring 2026, Capital Adequacy (E) Task Force, Attachment Five).* The motion passed unanimously.

2. Heard an Update from the Academy on the Proposed CLO C-1 Factors

Stephen Smith (Academy) presented on the proposed CLO C-1 factors (Attachment XX). He noted the "Post-Tax Factors" page, where the Academy updated the modeled C-1 factor for the A3 tranche to 80 basis points. Smith said this update was made in response to Working Group members' suggestion to take the average of 16 and 145 basis points from modeled factors derived from different plausible modeling decisions. Smith then highlighted the "Pre-Tax Factors" page, stating that the Academy calculated the pre-tax factors with greater precision. As such, these factors should be slightly different than what was exposed in the factor proposal.

3. Received Comments on Proposal 2026-12-IRE (CLO RBC Factors)

Joe Engelhard (Alternative Credit Council—ACC) and Andrew Berlin (Loan Syndications and Trading Association—LSTA) addressed the joint comment letter from the ACC and the LSTA (Attachment XX). Berlin expressed their support for implementing the Academy's CLO factors only for broadly syndicated loan (BSL) CLOs, effective 2026. He requested that middle-market (MM) CLOs, collateralized bond obligations (CBOs), and collateralized debt obligations (CDOs) continue to be afforded bonds' C-1 charges until further analysis is performed. Berlin said option 1 (rating-only) is supported, but he cautioned against flooring the CLO charges to bond charges. Engelhard recommended a one-year deferral to implement the CLO portfolio adjustment factor (PAF), citing concerns that the proposed segmentation methodology fails to acknowledge diversification benefits across asset classes.

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Clark asked whether the ACC and LSTA are advocating that independent modeling analyses for each type of asset-backed securities (ABS) be performed, e.g., MM CLOs, CBOs, CDOs, or various types of securitizations (student loans, credit card receivables, hard assets, etc.). Engelhard responded that some type of data-driven analysis would be appreciated but understanding materiality drives the judgment. Clark expressed concern that significant resources and time would be required to conduct full modeling studies. He believed some simplifying assumptions are needed to extrapolate the Academy's modeling results to other ABS. Cheung agreed and said that adopting the Academy's modeled factors today for other ABS subtypes does not preclude the Working Group from further refining the methodology. In the same vein, Cheung said that he is comfortable with not implementing floor-to-CLO factors, acknowledging that the commitment to future refinements will address his concerns, which prompted his prior recommendation to have a floor in the first place.

Marc Altschull (American Council of Life Insurers—ACLI) addressed the ACLI's comment letter (Attachment XX). Altschull expressed the ACLI's support for implementing the Academy's CLO factors to BSL CLOs only, effective 2026, with the commitment to continuous model refinements. In addition, the ACLI believes MM CLO warrants its own modeling analysis, given the distinct collateral structure, performance characteristics, and its rapid growth in insurers' balance sheets. While the ACLI appreciated the Academy's update to the A3 tranche factors, the ACLI does not support instituting a floor to the CLO risk-based capital (RBC) factors. Finally, the ACLI expressed concerns about the proposed PAF methodology, highlighting a potential knock-on effect that "inadvertently" increased the PAF applied to non-CLO bonds, thereby increasing capital requirements for those. The ACLI proposed including CLO issuers in the issuer count when determining PAF for non-CLO bonds.

Barlow said he was under the impression that the PAF methodology for bonds was developed only for bonds and, therefore, the Academy's proposed methodology right-sized the framework. Altschull said he understands that CLOs were included in the representative portfolio when the PAF methodology was first developed. Cheung viewed the ACLI's recommended practical solution as a temporary solution to address the lack of inter-asset correlational diversification credit within the current framework. Cheung advocated a more wholesome analysis of inter-asset correlation instead of adopting the ACLI's practical solution. Altschull welcomed fulsome analysis in the future and emphasized that the ACLI's proposed practical solution is intended as an interim solution. Smith agreed that some kind of covariance across asset classes should address the unintended consequence identified by the ACLI, but covariance is outside the scope of this CLO RBC project.

Daniel McCarty (American Investment Council—AIC) addressed the AIC's comment letter (Attachment XX). The AIC supports option 1 of the Academy's proposed factors applied to BSL CLOs only. The AIC recommends the Working Group defer application of the proposed framework to MM CLOs until additional modeling is completed in 2027.

Kim Welsh (Athene) addressed Athene's comment letter (Attachment XX). Athene supports the adoption of the Academy's framework and factors to all CLOs for year-end 2026, with calibration refinements targeted for 2027. Athene recommends adopting option 1 ratings only as a comparable attribute applicable to both MM CLOs and BSL CLOs, grounded in Athene's belief that credit rating providers use substantially similar core analytical approaches across BSL and MM CLOs. However, Athene does not oppose option 2. In addition, Athene recommends deferring the CLO portfolio adjustment factor and instead developing a full portfolio-level framework that operates across asset classes. Welsh said the Academy's proposed approach evaluates diversification only within the CLO asset class and does not recognize diversification benefits across the insurers' broader investment portfolio. This approach may incentivize concentration in whichever asset class carries the most favorable standalone capital requirement. Finally, Athene objects to the C-1 floor for CLOs, stating that the floor is neither analytically justified nor conceptually compatible with the proposed PAF methodology. Smith agreed with the incompatibility.

Eric Kolchinsky (Hildene Capital Management—Hildene) addressed Hildene's comment letter (Attachment XX). Kolchinsky urged the Working Group to forgo applying the Academy's framework to CBOs, CDOs, etc., to avoid sweeping in asset classes with the credit characteristics that are significantly different from those of BSL CLOs. Hildene's letter provided further context, using a trust preferred CDO (TRUPS CDO) as an example to illustrate that TRUPS CDOs have substantially different risk profiles and credit characteristics compared to BSL CLOs. Kolchinsky also pointed out that RBC arbitrage, which was the impetus of the CLO RBC project, does not exist among TRUPS CDOs. Coupled with the fact that TRUPS CDOs are usually rated by rating agencies that use the more conservative expected-loss approach, Hildene argued against applying CLO factors to other than BSL CLOs.

Clark asked how significant the holding of TRUPS CDOs is on insurers' balance sheets. Kolchinsky responded that it is likely not a significant allocation. Clark reiterated that it is unreasonable to expect detailed modeling of every asset class in a standalone. He supplemented that C-1 bond factors are also not calibrated with TRUPS CDOs in mind. He believes the judgment call here is which set of factors (bonds versus CLOs) is more pertinent to the asset class under consideration. Cheung agreed and asked Kolchinsky which set of factors is more representative of the risk of TRUPS CDOs. He posed the same question to commenters who advocated using bond factors for MM CLOs. He noted that no commenter demonstrated that the bond C-1 factor is a better choice for MM CLOs, and that the absence of such evidence led Cheung to view CLO factors as preferable for structured assets in general. Kolchinsky said he did not perform an analysis to draw a conclusion. Barlow shared Cheung's view about relativity. He thought that if the Working Group concluded that the bond factors are inappropriate for structured assets, the Working Group should opt for a better solution presented.

Francisco Paez (MetLife) addressed MetLife's comment letter (Attachment XX). Paez said MetLife believes the cash flow modeling approach used by the Academy is the appropriate way to capture unique risks of structured securities, especially the subordinated tranches of securitizations. However, Paez said there are still critical sensitivity assumptions that have not been incorporated into the Academy's model, due to timing constraints. MetLife believes that incorporating these sensitivity assumptions will allow the NAIC to accomplish its stated goal of achieving equal capital for equal risk. Considering this, Paez urged the Working Group to direct the Academy to finalize the modeling by incorporating key sensitivity assumptions, such as systemic risk, correlation, and recovery rate. After the model is fully built out, MetLife would like the Academy to test whether the RBC factors derived from the model substantially eliminate RBC arbitrage. If so, MetLife believes the model can serve as a roadmap for other structured securities. Cheung liked the idea of firming up modeling choices and creating a roadmap before evaluating the next asset class.

4. Discussed Potential Modifications and Adopted Proposal 2026-12-IRE MOD

Barlow directed the Working Group to the summary of decision points (Attachment XX). He planned to walk through the decision points with the goal of a motion to adopt the proposal. Barlow asked whether the Academy's proposed RBC factors should be applied to CLOs, or at least a segment thereof. He reminded everyone that the Working Group was charged by the Financial Condition (E) Committee to evaluate the appropriate RBC treatment for structured assets. Without hearing any objection from the Working Group, Barlow said the Working Group is to move forward with building out the RBC methodology for CLOs, effective 2026.

Barlow then asked if there were any objections to retaining the current 45% pre-tax factor for CLO residual tranches. Hearing no objection, Barlow moved to the third decision point. He sought feedback from the Working Group members on whether the Academy's modeled CLO factors should be applied to all CLOs, CBOs, and CDOs or to a subset thereof. Barlow pointed out that applying the new framework to all CLOs, CBOs, and CDOs is beneficial for inter-statement tie-out and validation, as they are grouped into a category in the annual statement. Another consideration is materiality. Barlow cited the 2025 filing statistics from the NAIC Structured Securities Group (SSG), showing that CLOs, including U.S. BSL CLOs, U.S. MM CLOs, European CLOs, etc., accounted for

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approximately 89% of the category. The balance of the category comprises CBOs, CDOs, TRUPS CDOs, and other securitizations.

Barlow added that MM CLOs, although not part of the population modeled by the Academy, are rated by rating agencies using similar methodologies; therefore, one could conclude it is appropriate to apply Academy factors, which use credit rating provider ratings as a comparable attribute. Hemphill asked whether the Academy could procure data to analyze the "All Other – including CBO, CDO, TRUPS CDOs, and Commercial Real Estate CLO" bucket. Smith said he is unsure.

Bruggeman observed that about a quarter of the category was attributable to MM CLOs. He wondered whether data were available to conduct a modeling analysis similar to that done on BSL CLOs. Smith responded that while data is available, the collateral underlying MM CLOs is not rated; therefore, the Academy must rely on credit estimates performed by the rating agencies for that collateral. Setting aside this extra element of subjectivity, Smith said there is a chance the Academy would come to a similar conclusion that rating is a comparable attribute for MM CLOs. Given this information, Barlow urged the Working Group to carefully consider the best use case for resources and the Academy's time. Eft said a materiality threshold should be established to help guide the Working Group in directing resources. Clark agreed.

Bumpus asked how material the CLO category was compared with life insurers' invested assets. Hankook Lee (NAIC) responded that it represents about 4% of life insurers' invested assets. Bumpus said that Virginia supports applying the Academy's CLO factors to the CLOs, CBOs, and CDOs category, as the Academy's work is viewed as a reasonable proxy for the category as a whole. He also reminded the Working Group that the Academy was tasked with evaluating the RBC treatment for all CLOs, not just BSL CLOs. Bumpus said that the Working Group had consensus in the past that BSL CLOs provide a reasonable proxy for other CLOs. Clark agreed with Bumpus. Reedy echoed, saying that based on the guiding principle of choosing the best option known today, California supports applying CLO factors to the entire category. That said, Reedy said the opportunity to revisit these decisions, based on new information presented or guidance from higher Task Forces, would be appreciated. Cheung echoed and would like the Working Group to discuss next steps, if possible.

Barlow conducted a straw poll to gauge whether the Working Group has consensus on applying the Academy's proposed factors to all CLOs, including BSL and MM CLOs, along with CBOs and CDOs. Apart from an abstention made by Ohio, all other Working Group members consented to have the Academy's proposed factors applied to all CLOs, CBOs, and CDOs.

Barlow then asked whether the Working Group members had a strong preference between option 1 (a rating-only approach) and option 2 (using tranche thickness as a secondary comparable attribute). Clark and Mears said Iowa supports option 1 because: a) the Working Group has already sent a referral to the Credit Rating Provider (E) Working Group to investigate the divergence among rating agencies' methodologies, and its work will better inform next steps for the Working Group; and b) option 2 is relatively more cumbersome to administer.

Carmello supported option 2. He inquired about the mechanism of levying higher charges for in-scope securities. Barlow walked through the proposal's structure and highlighted the mechanism of imposing a uniform 11.77% pre-tax surcharge when the tranche is considered in scope. Carmello inquired whether the Working Group has considered administering a factor that averages thin and thick tranches for NAIC 2.C. or below. Barlow said that represents a deviation from the Academy's proposal and requires regulatory judgment. Carmello confirmed with Smith that the Academy recommends option 2 for BSL CLOs only because the recommendation was informed by the Academy's work on BSL CLOs only.

Bumpus supported option 2 as well, but agreed to delay the implementation of option 2 if the Working Group sought to be informed by the Credit Rating Provider (E) Working Group's work prior to deciding. If so, option 1 will be an interim solution.

Barlow said that, given the noted divergence in views, he requested NAIC committee support to conduct an informal roll call poll. Illinois, Iowa, Missouri, Ohio, Texas and Wisconsin favored option 1, while California, Connecticut, Indiana, Minnesota, Nebraska, New Hampshire, New York, Virginia and Washington favored option 2. Florida abstained from the poll.

Barlow said that, with option 2 being the most favored, he would like to poll the Working Group members' preferences on whether option 2 should be applied to BSL CLOs only or to a broader scope. Carmello favored the latter and said the thin tranche surcharge should also be applied to MM CLOs. Clark agreed, stating that the lack of differentiation between BSL and MM CLOs in the annual statements makes carve-out operationally challenging. Eft, Bruggeman, and Hemphill said they shared an opposing view and favor a scope limited to BSL CLOs.

Barlow said that, given the noted divergence in views, he requested NAIC committee support to conduct an informal roll call poll. Connecticut, Illinois, Indiana, Missouri, Ohio, Texas, Virginia and Wisconsin favored a limited-scope application (BSL CLOs only), while California, Minnesota, New Hampshire, New York and Washington favored a broader-scope application. Florida, Iowa, and Nebraska abstained from the poll.

Barlow polled the Working Group, and no members expressed objection to retaining 4% as the bright-line for assessing tranche-thickness surcharge. Likewise, no Working Group members objected to the Academy's proposed method of identifying thin tranches by using the most current trustee reports, as opposed to using the tranche thickness as of origination.

Barlow then polled the Working Group on whether the CLO factors should be floored at bond C-1 factors. Cheung said his reservations about some assumptions in the Academy's model were the impetus for his suggestion to floor CLO factors. However, after hearing the commenters present, Cheung is now convinced that the appropriate way to address his reservations is to commit to continuous refinement of the modeling assumptions instead of instituting a floor. A voice vote was conducted by Barlow. California, Minnesota, and New York expressed their preference for a C-1 floor, while all other states supported no C-1 floor.

Barlow then turned to options for CLO PAF. Smith clarified that while the Academy presented two options for PAF, it deferred to the regulatory judgment and refrained from endorsing any option. Barlow said that, apart from the Academy's presented options, there are two more options on the table: a) defer implementing changes to PAF until 2027, or b) accommodate the ACLI's suggested approach to include CLO issuer count when computing size factors for non-CLO bonds. Carmello asked if the Academy could comment on the ACLI's counterproposal. Smith said the Academy is indifferent between the Academy's and the ACLI's proposed method. Bruggeman said deferral appears more favorable, but he sought to understand the downside of supporting other options on the table. Clark said he did not see any negative and therefore expressed support for the ACLI's counterproposal.

Cheung reiterated his view that the ACLI's counterproposal is more of a simplified solution to address the lack of inter-asset correlation adjustment in the current RBC framework. Barlow agreed and stated that the ACLI's counterproposal will be characterized as a temporary solution if adopted for 2026. He recommended that the Working Group revisit the PAF methodology in the future. To help streamline the poll, Barlow asked the Working Group members to choose between the ACLI counterproposal and deferring the PAF methodology until 2027. All Working Group members were in favor of the ACLI's counterproposal.

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Barlow said that, in light of poll results, he would like to seek a motion to adopt, with effect from 2026, proposal 2026-12-IRE (CLO RBC Factors) with the following modifications: a) pre-tax factors recommended by the Academy are applied to all BSL and MM CLOs, CBOs, and CDOs; b) BSL CLOs with NAIC Designation 2.C. or lower and current tranche thickness equal to or less than 4% will be assessed surcharge of 11.77% pre-tax; c) CLO factors are not floored to bond C-1 factors; and d) CLOs will have a PAF of 1.0, but as a temporary solution, the ACLI's counterproposal of including CLOs in non-CLO bond issuer count will be accommodated. Slutsker made a motion accordingly. Eft suggested the motion should include specific next steps to review MM CLOs. Reedy countered and proposed to expand the motion to state that "the Working Group would like the opportunity to revisit these decision points in the future as new information emerges or new guidance from higher task forces arises".

Slutsker agreed to the amended motion, seconded by Reedy, to adopt proposal 2026-12-IRE with modifications discussed. The motion passed unanimously.

Barlow said the Working Group plans to meet to discuss elements of the proposal that should receive additional consideration for 2027 and to prioritize future work.

Having no further business, the Risk-Based Capital Investment Risk and Evaluation (E) Working Group adjourned.

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Draft: 10/9/26

Risk-Based Capital Investment Risk and Evaluation (E) Working Group
Virtual Meeting
October 5, 2026

The Risk-Based Capital Investment Risk and Evaluation (E) Working Group of the Capital Adequacy (E) Task Force met Oct. 5, 2026. The following Working Group members participated: Philip Barlow, Chair (DC); Thomas Reedy, Vice Chair (CA); Wanchin Chou (CT); Carolyn Morgan (FL); Carrie Mears and Kevin Clark (IA); Matt Cheung (IL); Roy Eft (IN); Fred Andersen (MN); Tadd Wegner (NE); Jennifer Li (NH); Bob Kasinow and William B. Carmello (NY); Dale Bruggeman (OH); Rachel Hemphill (TX); Doug Stolte and Dan Bumpus (VA); Steve Drutz and Katy Bardsley (WA); and Amy Malm (WI).

1. Received Comments on a Presentation by the Academy on the CLO RBC Project, Focusing on Residual Tranches

Barlow said the Working Group exposed a presentation by the American Academy of Actuaries (Academy) on the collateralized loan obligation (CLO) risk-based capital (RBC) project, focusing on residual tranches (Attachment XX). The public comment period ended July 6, and one comment letter was received.

Marc Altschull (American Council of Life Insurers—ACLI) addressed the ACLI's comment letter (Attachment XX). He expressed the ACLI's appreciation for the continued work on a transparent, analytically grounded framework for CLO C-1 factors, and he said the ACLI supports the Working Group's decision to enhance the model. Altschull said the central point of the letter is that the current results should inform the next phase of work rather than be treated as the final analytical endpoint. He said the planned model enhancements and validation should be completed before broader calibration decisions are finalized.

Barlow said the topic of model enhancement would be discussed further under the next agenda item. He clarified that any future work will include a review of residual tranches, which could also be affected.

2. Received Comments on the Exposure of the Academy's Excerpts from its Dec. 15, 2025, C-1 Subcommittee Presentation

Barlow said the Working Group received three comment letters (Attachment XX) on the exposure of the Academy's presentation excerpts (Attachment XX), which will help inform next steps for the CLO work.

Joe Engelhard (Alternative Credit Council—ACC) and Andrew Berlin (Loan Syndications and Trading Association—LSTA) addressed their Sept. 4 joint comment letter. Engelhard said both organizations support continued refinement of the CLO C-1 assumptions and appreciated the level of detail in the Academy's sensitivity analysis. He said the letter supports the Working Group's direction to the Academy to continue refining the assumptions on recovery, repurchase price, and prepayment. Engelhard said the letter contains four key points.

First, Berlin addressed the probability of default. He said the Academy's default assumptions are based on a corporate bond model calibrated to all issuers, while CLO collateral consists of loans. Citing Moody's Ratings data across 29 annual cohorts from 1996 to 2024, he said loan issuers default at 0.63 times the all-issuer rate at one year and 0.73 times at three years. The ratio rises to 0.81 times at five years and 0.85 times at seven years. Berlin said horizon matters because CLO tranches typically have weighted average lives of roughly five to seven years absent a call, reflecting a reinvestment period of four to five years followed by amortization. Berlin acknowledged that default frequency was not among the three items on which the Working Group requested comment.

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However, he said it cannot be separated from them because recovery and default frequency are the two inputs to expected loss. He said the ACC and the LSTA can provide supporting data.

On prepayment and repurchase price, Berlin said the zero-prepayment baseline used by the Academy lies outside 27 years of index history, during which prepayments never fell below 8.69%. The organizations included in their joint comment letter a section that sets out a specific alternative specification, which they believed was conservative.

Engelhard addressed recovery. He said the principal request of the organizations is that the Academy conduct separate loss given default (LGD) analyses for broadly syndicated loan (BSL) and middle-market (MM) loan collateral, rather than applying a single assumption to both. He said the calibration was built on BSL data, and an LGD derived from market prices presupposes a liquid secondary market. Engelhard said this holds for BSLs but not for MM loans, whose recoveries depend more on concentrated lender control, covenant structure, and negotiated workouts. He said applying the same LGD overstates the capital charge.

Engelhard said the fourth point is procedural. The organizations ask that the Working Group direct the Academy to expose the full set of assumption documentation, including the composition of the deal samples and the resulting sensitivity output.

Barlow emphasized that the Working Group needs to be cognizant of the Academy's time and resources. The model refinement project is targeted for the remainder of the calendar year. As such, the Working Group intends to focus on the items it considers most important, based on the comments received and what the Academy indicates it can reasonably accomplish.

Altschull addressed the ACLI's comment letter. He said the ACLI supports continued evaluation of the assumptions identified in the exposure, given the Academy's sensitivity analysis showing that these assumptions can materially influence modeled tail losses and the resulting RBC factors. Altschull said the ACLI's primary recommendation is that the assumptions be evaluated both individually and collectively. He said correlation, recovery rates, probability of default, collateral repurchase prices, and prepayment rates all interact within the model. Refining any one assumption without considering its relationship to others could unintentionally distort the overall calibration. Altschull also encouraged the Academy to expand its analysis beyond the limited sample of transactions previously tested and to clearly explain the data, methodologies, and rationale supporting any recommended calibrations.

Mike Consedine (Athene) addressed Athene's comment letter. He said Athene supports the framework, supported its adoption for year-end 2026, and wants to continue improving it. He said Athene's position is largely aligned with other commentators'. Consedine said Athene's request centers on one idea: capital should measure the risk of the loans a CLO actually holds. He described this as equal capital for equal risk, a principle the NAIC has already adopted. On the correlation assumption, which Consedine described as the most sensitive input in the model, Consedine said Athene is not asking for the assumption to be moved up or down, only for the work to be completed and the calculations shown. Finally, he encouraged the Academy to test the changes together and to let the risk, rather than the direction, set the number. He said Athene has performed its own analysis and offered to share it with the Academy and its domestic regulators.

Stephen Smith (Academy) appreciated the comments and the requests to perform several categories of sensitivities. However, he said some are more achievable in a short time frame than others. If directed by the Working Group, Smith said the Academy is well-positioned to complete two sensitivities. The first addresses prepayments and purchase prices, for which the Academy has already begun preliminary work on an improved version of the earlier sensitivity. The second is a correlation sensitivity, which he said can be updated in the model

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without significant effort. Smith agreed with commenters that the sensitivities should also be run on a combined basis. He said the impact of each change on its own cannot simply be added together, so a combined run would show the extent to which they offset one another.

Smith said the two other sensitivities, default rates and recovery, are worthwhile, but he expressed concern about the timeline. Given the central role of default rates, Smith said a change would not be a single sensitivity. He said it would require redoing significant parts of the work and would be nearly impossible to complete this year. On recovery, Smith said that given the built-in conservatism in the default rates, updating recoveries without corresponding changes to default rates would produce misleading results. Smith therefore recommended setting aside default rates and recoveries and focusing on narrower, targeted sensitivities for correlation, purchase price, and prepayment speeds, which he described as the most realistic option.

Barlow noted that one reason for undertaking model refinement now is that the Academy has the model, data, and team already in place. He asked whether default rates and recovery assumptions could be revisited in the future or would require insurmountable effort. Smith said revisiting the assumptions in the future would not be impossible. The Academy is working to finalize the model documentation for release. Model code and documentation would assist any future updates. He said the biggest complication is that certain vendor data must be destroyed at the end of the project, so comparable data would need to be obtained again.

Altschull asked to what extent forgoing refinement of the default and recovery assumptions would affect the analysis of future asset-backed securities (ABS) asset types using this model under the structured products road map. Smith said the model built for CLOs is largely consistent with the C-1 bond model. For the rest of the ABS, Smith said the underlying collateral is often not corporate credit, let alone rated, so a bottom-up default model will likely be needed rather than reliance on consistency with corporate bonds. As a result, he said he does not expect the default rate decision for CLO collateral to have a significant downstream impact on the ABS work.

Barlow asked whether the work needed to refine default rate and recovery assumptions is primarily technical changes to the model or the development of appropriate assumptions. Smith said it is a combination of both. He described model building as an iterative process in which a modeler enters the assumptions believed to be correct, obtains results that may be unintuitive, and then investigates what produced them, thereby leading to potential changes to the assumptions used.

Barlow sought the Working Group members' thoughts on whether to proceed with further model refinement as suggested by the Academy: that is, the Academy would run two sensitivities and a combination of the two. The first would use more realistic prepayment speeds and purchase prices for the underlying loans, replacing the current assumptions of zero prepayment and purchase at par in all cases. The second would change the correlation assumption across loans. The third would run both changes simultaneously to determine the extent to which they offset each other. Bumpus said Virginia supports the path forward laid out by the Academy and understands the timing sensitivity. Hearing no other comments or objections from Working Group members or interested parties, Barlow directed the Academy to proceed.

3. Reviewed ABS Reported in the 2025 Annual Statement Filings

Barlow said the purpose of reviewing the summary of ABS reported in the 2025 Annual Statement Filings (Attachment XX) is to help identify the next category of ABS for the Working Group and the Academy to address. He said NAIC committee support compiled the information from the 2025 Schedule D, Part 1, Section 2 filings and broke down the reported categories.

Hankook Lee (NAIC) said that as the Working Group considers expanding its scope beyond CLOs, NAIC committee support reviewed Schedule D, Part 1, Section 2 of the year-end 2025 filings by reported ABS category and collateral type. He said they also performed an additional ABS deal-type review within each category, mapping a little over $1.4 trillion of the $1.6 trillion of total ABS reported on the schedule. Lee said two ABS subcategories currently receive different regulatory treatment. The CLO, collateralized bond obligation (CBO), and collateralized debt obligation (CDO) category is now subject to a separate CLO-specific RBC framework. Residential mortgage-backed securities (RMBS) and commercial mortgage-backed securities (CMBS) are subject to financial modeling by the NAIC.

Lee said the financial ABS shown at the top of the exhibit, such as agency and non-agency mortgage-backed securities, and the CLO, CBO, and CDO lines, account for nearly three-quarters of the $1.6 trillion reported. He said the remaining subtypes, such as non-financial ABS and other financial ABS, are required to report with additional collateral-type information. When grouped by collateral type, the primary collateral types reported appear to be individual obligations and corporate obligations. Individual obligations include credit cards, auto loans, personal loans, and student loans collateral, while corporate obligations include commercial leases.

Lee cautioned that the assets backing these collateral types differ considerably in their risk-bearing nature, including asset life and counterparty risk. Therefore, assets reported under one collateral type should not necessarily be considered uniform in their characteristics. Lee said that overall, committee support found the expected ABS subtypes in the appropriate buckets, although misreporting exists. He noted that a meaningful amount is reported under the “other” ABS categories and “other” collateral types. Based on their review, some of these holdings could be allocated to more specific collateral types, to be precise.

Lee said committee support also examined whether other ABS subtypes carry CLO-like characteristics, both in their collateral, such as corporate credit, and in their structural features. He said that at first glance, beyond the current CLO, CBO, and CDO category, no major ABS subtype closely resembles CLOs. He said the closest are certain fund financing vehicles, such as investment funds and rated note feeder structures, some of which are already reported on the CLO, CBO, and CDO line.

Mears sought clarification on whether feeder fund structures are already being reported on the CLO line. Lee said that, while not large relative to the total, committee support identified feeder funds and other fund-financing or investment-fund structures reported there. Mears said this makes sense, although there is no direct guidance on the matter.

Barlow said he did not expect the Working Group to select the next category at this meeting, but the information is a useful starting point. Barlow proposed exposing the document for comment. Clark supported the exposure to allow more time for review. He suggested requesting input on whether the categories, which are presented granularly, could be addressed in broader groupings rather than as stand-alone projects for each sub-line. Clark identified three potential thematic groupings: 1) leaseback transactions; 2) consumer finance; and 3) fund finance. Reedy agreed with Clark. He suggested asking commenters for insight into the availability of data and inputs, which would help the Working Group estimate timelines for future projects.

Hearing no objection from the Working Group, Barlow directed a 30-day exposure of the summary, along with cover questions to be drafted by NAIC committee support to solicit feedback on project prioritization.

4. Adopted its Working Agenda

Barlow summarized the changes to the working agenda (Attachment XX). For item IR1, he said NAIC committee support identified areas in the asset concentration page instructions that could potentially be aligned with the Supplemental Investment Risk Interrogatories (SIRI) under Proposal 2025-12-IRE. The proposal was ultimately withdrawn due to a lack of consensus on the treatment of Securities Valuation Office (SVO)-designated mutual funds. Barlow said committee support suggest seeking directions from the Working Group on whether to proceed with or dispose of this item, which the Working Group will consider at a future time.

Barlow said items IR2 and IR3 are generally complete because the Working Group decided not to proceed with Proposal 2025-12-IRE. For items IR4, IR5, and IR6, committee support added milestones to the projects.

Eft made a motion, seconded by Reedy, to adopt the Working Group's working agenda. The motion passed unanimously.

5. Discussed Other Matters

Barlow said NAIC is developing a BSL CLO thin-tranche safe harbor list. He said the list is not yet fully developed but is expected to be released well before companies need it, and it will likely be discussed further at the Fall National Meeting.

Barlow reminded the Working Group that the portfolio adjustment factor (PAF) was changed for this year with the intention of revisiting it.

Barlow also noted that the Working Group will hold an in-person meeting in Dallas, TX.

Having no further business, the Risk-Based Capital Investment Risk and Evaluation (E) Working Group adjourned.

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In order to facilitate advancing the work of the Risk-Based Capital Investment Risk and Evaluation (E) Working Group in evaluating proper risk-based capital (RBC) treatment for Asset Backed Securities (ABS), the following Summary titled *Asset-Backed Securities Reported in 2025 Statutory Filings - Schedule D, Part 1, Section 2 - For all Types of Businesses* was prepared by the NAIC staff.

The Working Group has directed a 30-day public exposure period ending Nov 5, 2026 (Thursday).

Please provide your comments on the following questions:

1. Please comment on how you would use the Summary to inform the future work of the Working Group.
2. Regulators have identified the following three broad groups of asset-backed securities as priority for the Working Group. Please comment on your support/reservations:
   - Lease-backed Securities
   - ABS backed by individual obligations (e.g. consumer finance)
   - Fund finance ABS (e.g. Fund financing, Rated Note Feeder etc.)
3. Please comment on availability of data and inputs to model the priority ABS asset type(s) you identified.

# Asset-Backed Securities Reported in 2025 Statutory Filings - Schedule D, Part 1, Section 2 - For all Types of Businesses

Total Cash and Invested Assets (2025) 9,580,585,000,000 https://content.naic.org/sites/default/files/capital-markets-special-reports-asset-mix-ye2025.pdf

| ABS_LINE_NO | Schedule D, Part 1, Section 2 Line No. | SCD_COLL_TYPE_DESC | BACV | PRIMARY ABS TYPES (SSG Observation) | As a % of Total ABS | As a % of Total Cash and Invested Assets | 2026 RBC Methodology |
|---|---|---|---|---|---|---|---|
| **Agency CMBS - Guaranteed** | **1029999999** | | **38,007,299,685** | **MBS - U.S. Full Faith; ABS - SBA (Guaranteed)** | **2.4%** | **0.4%** | **Bond C-1 Factors** |
| **Agency CMBS - Not Fully-Guaranteed** | **1049999999** | | **54,464,026,732** | **MBS - Agency** | **3.4%** | **0.6%** | **Bond C-1 Factors** |
| **Agency RMBS - Guaranteed** | **1019999999** | | **58,531,659,951** | **MBS - U.S. Full Faith** | **3.6%** | **0.6%** | **Bond C-1 Factors** |
| **Agency RMBS - Not Fully-Guaranteed** | **1039999999** | | **287,305,152,051** | **MBS - Agency** | **17.9%** | **3.0%** | **Bond C-1 Factors** |
| **CLO/CBO/CDO (Affiliated)** | **1109999999** | | **28,841,535,217** | **CLO - MM; CLO - BSL; Fund Financing/Rated Note Feeder; ABS - Project Finance** | **1.8%** | **0.3%** | **CLO C-1 Factors** |
| **CLO/CBO/CDO (Unaffiliated)** | **1099999999** | | **286,917,662,212** | **CLO - BSL; CLO - MM; CDO- TruPS; CBO; Investment Fund Debt/Fund Financing/Rated Note Feeder** | **17.8%** | **3.0%** | **CLO C-1 Factors** |
| **Equity Backed Securities (Affiliated)** | **1329999999** | | **17,249,668,922** | **Need Addl. Review** | **1.1%** | **0.2%** | **Bond C-1 Factors** |
| **Equity Backed Securities (Unaffiliated)** | **1319999999** | | **36,783,648,909** | **Need Addl. Review** | **2.3%** | **0.4%** | **Bond C-1 Factors** |
| **Non-Agency CMBS (Affiliated)** | **1089999999** | | **2,202,204,407** | **CMBS; CRE CLO** | **0.1%** | **0.0%** | **Bond C-1 Factors** |
| **Non-Agency CMBS (Unaffiliated)** | **1079999999** | | **204,431,331,480** | **CMBS; CRE CLO** | **12.7%** | **2.1%** | **Bond C-1 Factors** |
| **Non-Agency RMBS (Affiliated)** | **1069999999** | | **1,559,890,493** | **RMBS** | **0.1%** | **0.0%** | **Bond C-1 Factors** |
| **Non-Agency RMBS (Unaffiliated)** | **1059999999** | | **187,450,498,894** | **RMBS; Muni - Housing Bonds** | **11.7%** | **2.0%** | **Bond C-1 Factors** |
| Non-Financial ABS - Full Analysis - Lease-Backed Securities (Affiliated) | | No Collateral Type | - | | | | |
| | | Other | 13,189,900 | ABS - Leases/CTLs/Ground Leases | | | |
| **Non-Financial ABS - Full Analysis - Lease-Backed Securities (Affiliated) Total** | **1729999999** | | **13,189,900** | | **0.0%** | **0.0%** | **Bond C-1 Factors** |
| Non-Financial ABS - Full Analysis - Lease-Backed Securities (Unaffiliated) | | Cash Flow Rights | 34,464,326 | ABS - Various Leases (Commercial Equipment & Business Assets, etc.) | | | |
| | | Corporate/Industrial Obligations | 1,572,867,743 | ABS - Various Leases (e.g. Container, Railcar, etc.) | | | |
| | | Individual Obligations | 1,196,103,019 | ABS - Various Leases (e.g. Automobile, Automobile - Fleet, etc.) | | | |
| | | Non-Standard Home Loan Equity | 19,937,008 | Single Family Rental Securitization | | | |
| | | Other | 11,378,492,889 | ABS - Various Leases (e.g. Data Center, Real Estate Leases, etc.) | | | |
| | | Other Leases | 14,873,655,345 | ABS - Various Leases (e.g. Aircraft, Container, Railcar, Business Assets, etc.) | | | |
| | | Real Estate Leases | 10,527,124,262 | ABS - Various Leases (e.g. Data Center, Real Estate Leases, etc.) | | | |
| **Non-Financial ABS - Full Analysis - Lease-Backed Securities (Unaffiliated) Total** | **1719999999** | | **39,602,644,592** | | **2.5%** | **0.4%** | **Bond C-1 Factors** |
| Non-Financial ABS - Full Analysis - Other (Affiliated) | | Cash Flow Rights | 203,370,182 | ABS - Commercial Receivables (e.g. Royalties) | | | |
| | | Corporate/Industrial Obligations | 897,357,491 | CMBS/CRE Securitization | | | |
| | | Other | 279,471,225 | ABS - Commercial Receivables (e.g. Royalties) | | | |
| **Non-Financial ABS - Full Analysis - Other (Affiliated) Total** | **1749999999** | | **1,380,198,898** | | **0.1%** | **0.0%** | **Bond C-1 Factors** |
| Non-Financial ABS - Full Analysis - Other (Unaffiliated) | | Cash Flow Rights | 21,746,171,316 | Whole Business Securitization | | | |
| | | Corporate/Industrial Obligations | 2,940,851,455 | Whole Business Securitization; Lease Backed and Busienss Assets | | | |
| | | Individual Obligations | 1,758,398,842 | ABS - Consumer Credit/Financing | | | |
| | | No Collateral Type | 10,000,000 | ABS - Other (e.g. Corporate Asset Backed) | | | |
| | | Non-Standard Home Loan Equity | 361,664,799 | Single Family Rental Securitization | | | |
| | | Other | 21,243,196,488 | ABS - Commercial Leases/Financing and Corporate Credit (e.g. Whole Business Securitization and Various Leases and Corporate Asset Backed); ABS - Leases/CTLs/Ground Leases | | | |
| | | Other Leases | 2,204,737,808 | Various Leases | | | |
| | | Real Estate Leases | 193,908,947 | Various Leases | | | |
| **Non-Financial ABS - Full Analysis - Other (Unaffiliated) Total** | **1739999999** | | **50,458,929,655** | | **3.1%** | **0.5%** | **Bond C-1 Factors** |
| Non-Financial ABS - Practical Expedient - Lease-Backed Securities (Affiliated) | | Corporate/Industrial Obligations | 155,846,943 | ABS - Commercial Leases/Financing and Corporate Credit | | | |
| | | Other | 2,775,308,086 | ABS - Commercial Leases/Financing and Corporate Credit | | | |
| | | Other Leases | 50,570,208 | ABS - Commercial Leases/Financing and Corporate Credit | | | |
| **Non-Financial ABS - Practical Expedient - Lease-Backed Securities (Affiliated) Total** | **1529999999** | | **2,981,725,237** | | **0.2%** | **0.0%** | **Bond C-1 Factors** |
| Non-Financial ABS - Practical Expedient - Lease-Backed Securities (Unaffiliated) | | Cash Flow Rights | 110,295,681 | ABS - Commercial Leases/Financing and Corporate Credit | | | |
| | | Corporate/Industrial Obligations | 768,865,130 | ABS - Commercial Leases/Financing and Corporate Credit; ABS - Leases/CTLs/Ground Leases | | | |
| | | Individual Obligations | 1,618,692,158 | ABS - Commercial Leases/Financing and Corporate Credit; ABS - Consumer Credit/Financing | | | |
| | | Other | 6,111,100,381 | Various Leases | | | |
| | | Other Leases | 20,801,812,976 | Various Commercial Leases (e.g. Aircraft, Automobile, Container, Railcar, Business Assets, etc.) | | | |
| | | Real Estate Leases | 6,903,038,991 | Various Real Estate Leases | | | |
| **Non-Financial ABS - Practical Expedient - Lease-Backed Securities (Unaffiliated) Total** | **1519999999** | | **36,313,805,317** | | **2.3%** | **0.4%** | **Bond C-1 Factors** |
| Non-Financial ABS - Practical Expedient - Other (Affiliated) | | Cash Flow Rights | 557,241,512 | ABS - PACE/CPACE | | | |
| | | Corporate/Industrial Obligations | 300,834,391 | Corporate Credit | | | |
| | | No Collateral Type | - | | | | |
| | | Other | 202,170,259 | Various | | | |
| **Non-Financial ABS - Practical Expedient - Other (Affiliated) Total** | **1549999999** | | **1,060,246,162** | | **0.1%** | **0.0%** | **Bond C-1 Factors** |
| Non-Financial ABS - Practical Expedient - Other (Unaffiliated) | | Cash Flow Rights | 11,071,558,883 | ABS - Commercial Leases/Financing and Corporate Credit; ABS - Commercial Receivables | | | |
| | | Corporate/Industrial Obligations | 9,529,683,607 | ABS - Commercial Leases/Financing and Corporate Credit; ABS - Commercial Receivables | | | |
| | | Individual Obligations | 1,847,604,619 | ABS - Student Loans; ABS - Commercial Leases/Financing and Corporate Credit | | | |
| | | No Collateral Type | - | | | | |
| | | Non-Standard Home Loan Equity | 764,534,869 | Various MBS/ABS (e.g. Reverse Mortgage, Manufacturing Housing) | | | |
| | | Other | 24,142,715,735 | ABS - Stranded Utilities; CRE CLO; CLO MM | | | |
| | | Other Leases | 1,246,509,655 | ABS - Commercial Leases/Financing and Corporate Credit | | | |
| | | Real Estate Leases | 43,195,740 | ABS - Leases/CTLs/Ground Leases | | | |
| **Non-Financial ABS - Practical Expedient - Other (Unaffiliated) Total** | **1539999999** | | **48,645,803,108** | | **3.0%** | **0.5%** | **Bond C-1 Factors** |
| Other Financial ABS - Not Self-Liquidating (Affiliated) | | Other | 270,088,667 | CRE CLO | | | |
| **Other Financial ABS - Not Self-Liquidating (Affiliated) Total** | **1349999999** | | **270,088,667** | | **0.0%** | **0.0%** | **Bond C-1 Factors** |
| Other Financial ABS - Not Self-Liquidating (Unaffiliated) | | Cash Flow Rights | 676,776,033 | CMBS; CRE CLO | | | |
| | | Corporate/Industrial Obligations | 1,310,258,677 | ABS - Commercial Leases/Financing and Corporate Credit | | | |
| | | Individual Obligations | 323,761,705 | ABS - Consumer Credit/Financing | | | |
| | | Non-Standard Home Loan Equity | 160,160,071 | RMBS - HELOC/CES; ABS - HEA | | | |
| | | Other | 4,548,812,778 | Investment Fund Debt/Fund Financing/Rated Note Feeder; Muni - Housing Bonds | | | |
| | | Other Leases | 85,883,543 | Various | | | |
| | | Real Estate Leases | 31,425,424 | ABS - Leases/CTLs/Ground Leases | | | |
| **Other Financial ABS - Not Self-Liquidating (Unaffiliated) Total** | **1339999999** | | **7,137,078,231** | | **0.4%** | **0.1%** | **Bond C-1 Factors** |
| Other Financial ABS - Self-Liquidating (Affiliated) | | Cash Flow Rights | 98,680,255 | ABS - Consumer Credit/Financing | | | |
| | | Corporate/Industrial Obligations | 3,442,449,685 | CLO; ABS - Consumer Credit/Financing | | | |
| | | Individual Obligations | 2,213,266,926 | ABS - Consumer Credit/Financing | | | |
| | | No Collateral Type | - | | | | |
| | | Non-Standard Home Loan Equity | 401,570,727 | ABS - Consumer Credit/Financing (e.g. Residential Solar, Home Improvement Equipment, etc.) | | | |
| | | Other | 14,726,774,578 | Investment Fund Debt/Fund Financing/Rated Note Feeder; ABS - Consumer Credit/Financing; ABS - Commercial Leases/Financing and Corporate Credit | | | |
| | | Other Leases | 53,873,965 | ABS - Commercial Leases | | | |
| **Other Financial ABS - Self-Liquidating (Affiliated) Total** | **1129999999** | | **20,936,616,136** | | **1.3%** | **0.2%** | **Bond C-1 Factors** |
| Other Financial ABS - Self-Liquidating (Unaffiliated) | | Cash Flow Rights | 6,343,286,392 | ABS - Commercial Leases/Financing and Corporate Credit; Investment Fund Debt/Fund Financing/Rated Note Feeder; ABS - Structured Settlements | | | |
| | | Corporate/Industrial Obligations | 17,616,681,403 | ABS - Commercial Leases/Financing; ABS - Business Credit/Financing; Investment Fund Debt/Fund Financing/Rated Note Feeder | | | |
| | | Individual Obligations | 83,013,800,187 | ABS - Consumer Credit/Financing (e.g. Automobiles, Consumer Loan, Credit Card, Student Loan, etc.) | | | |
| | | No Collateral Type | 1,569,058 | ABS - Consumer Credit/Financing | | | |
| | | Non-Standard Home Loan Equity | 9,813,717,044 | RMBS - Subprime; RMBS - HELOC/CES; Consumer Loans (Home Improvement) | | | |
| | | Other | 75,786,961,119 | Investment Fund Debt/Fund Financing/Rated Note Feeder; ABS - PACE/CPACE; ABS - Consumer Credit/Financing | | | |
| | | Other Leases | 1,762,628,628 | ABS - Commercial Leases/Financing; ABS - Consumer Credit/Financing | | | |
| | | Real Estate Leases | 1,570,173,363 | Single Family Rental Securitization | | | |
| **Other Financial ABS - Self-Liquidating (Unaffiliated) Total** | **1119999999** | | **195,908,817,194** | | **12.2%** | **2.0%** | **Bond C-1 Factors** |
| **Grand Total** | | | **1,608,453,722,050** | | **100.0%** | **16.8%** | |

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November 2, 2026

Risk-Based Capital Investment Risk and Evaluation (E) Working Group
National Association of Insurance Commissioners
1100 Walnut Street, Suite 1500
Kansas City, MO 64106-2197

Via email: mchang@naic.org

**Re: Comments on the NAIC staff summary of asset-backed securities reported in 2025 statutory filings and the Working Group's priority ABS asset types**

Dear Chairman and Members of the Risk-Based Capital Investment Risk and Evaluation (E) Working Group:

## I. Introduction and summary

The Alternative Credit Council,[1] the private credit affiliate of the Alternative Investment Management Association Ltd (AIMA), appreciates the opportunity to provide initial comments

[1] The Alternative Credit Council (ACC) is a global body that represents asset management firms in the private credit and direct lending space. It currently represents 250 members that manage over US$2 trillion of private credit assets. The ACC is an affiliate of AIMA and is governed by its own board, which ultimately reports to the AIMA Council. ACC members provide an important source of funding to the economy. They provide finance to mid-market corporates, SMEs, commercial and residential real estate developments, infrastructure, and the trade and receivables business. The ACC's



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on the Working Group's exposure of the NAIC staff summary titled Asset-Backed Securities Reported in 2025 Statutory Filings, Schedule D, Part 1, Section 2, For all Types of Businesses (the Summary), and on the three broad groups of asset-backed securities (ABS) that regulators have identified as priorities for the Working Group's review of risk-based capital (RBC) treatment. Our comments respond to the Working Group's question on how to sequence its review and should not be read as accepting the three groups as permanent categories for RBC purposes. The three groups do not reflect how asset-based finance markets underwrite, rate or report these assets. Markets distinguish first between securities repaid from the contractual cash flows of financial assets and securities that depend on the value or use of hard assets, a distinction the NAIC's principles-based bond definition already captures in the financial and non-financial ABS reporting lines. Section III sets out a framework built on that distinction.

ACC members manage private credit and asset-based finance strategies for US life insurers, and many originate, structure or invest in the lease-backed, consumer and fund finance assets the Working Group has identified. Our members therefore have a direct interest in RBC factors that are accurately calibrated, and a practical ability to help the Working Group obtain the data needed to calibrate them.

Our central message is that this next phase of the Working Group's ABS work should be driven by the NAIC's Principles for RBC model development, particularly the principle of equal capital for equal risk and the use of data-driven methodologies, with assessments of model performance and model validation where possible.[2] We appreciate the Working Group's decision to ask, in its third question, what data and inputs are available to model the priority asset types. That question belongs at the front of the process. The Working Group's CLO workstream[3] demonstrated both the value of asset-specific modeling and the challenges of relying on proxy assumptions where asset-specific data is thin. The Working Group should not set factors for any ABS asset type until it has identified the key risk drivers for testing, assembled the data needed to analyze those factors, and published the evidence on which its conclusions rest.

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core objectives are to provide guidance on policy and regulatory matters, support wider advocacy and educational efforts and generate industry research to strengthen the sector's sustainability and wider economic and financial benefits. Alternative credit, private debt or direct lending funds have grown substantially in recent years and are becoming a key segment of the asset management industry. The ACC seeks to explain the value of private credit by highlighting the sector's wider economic and financial stability benefits.

[2] NAIC, Principles for RBC Requirements (Section F of the RBC Preamble), adopted December 2025, Principles 4 and 10, https://content.naic.org/sites/default/files/inline-files/Dec%202025%20Adopted%20Principles.pdf.

[3] Sidley Austin LLP, Regulatory Update: NAIC Adopts New Risk-Based Capital Charges for Collateral Loans and Collateralized Loan Obligations (July 2026), https://www.sidley.com/en/insights/newsupdates/2026/07/regulatory-update-naic-adopts-new-rbc-charges-for-collateral-loans-and-clos. The new CLO factors apply to broadly syndicated loan CLOs, middle market CLOs, CBOs and CDOs. The Life Risk-Based Capital (E) Working Group separately adopted collateral loan factors based on underlying collateral type on June 11, 2026, effective for year-end 2027.

Our research indicates that data availability differs across the three groups, principally in how much is public and how much is held under confidentiality protections. Public consumer ABS benefits from SEC-mandated asset-level disclosure, performance histories spanning multiple credit cycles and published rating agency indices. Lease-backed ABS has rich but dispersed data, including independent appraisals, servicer reports and a recent, severe stress episode in aviation. Fund finance has substantial performance data, though less of it is public than for consumer ABS. Managers and lenders hold facility-level histories covering capital calls, loan-to-value, defaults and recoveries, and rating agencies have rated or assessed several hundred subscription facilities, NAV loans and collateralized fund obligations. That record shows very few defaults or losses. Because this data is held privately and ratings are frequently issued on a private letter basis, it does not appear in public disclosure, but the ACC and its members would be glad to share it with the Working Group on an anonymized, aggregated basis under appropriate confidentiality protections. These differences should shape the Working Group's sequencing, its methodology and the role interested parties play in supplying data.

In summary:

- **Use of the Summary:** The Summary is a sound scoping and prioritization tool, but it is not a calibration dataset.
- **Market taxonomy:** The three groups combine a contract form, an obligor type and a borrower type, and each spans exposures with different risk drivers. We recommend organizing the review around source of repayment and pool composition, mapped to the financial and non-financial ABS reporting lines the Working Group already uses.
- **Lease-backed securities:** We support prioritization, provided the Working Group segments the group by its primary risk drivers (its comparable attributes) and distinguishes structures that depend on lessee credit from structures that depend on residual asset values.
- **Individual obligations:** We support a targeted review. Senior tranches of public, prime consumer ABS are among the most data-rich assets insurers hold.
- **Fund finance:** We have significant reservations about analyzing fund finance as a single category, because it combines structurally distinct products. The Working Group should first resolve classification and reporting questions and focus on the comparable attributes of the underlying collateral rather than the form of the wrapper.
- **Data:** The ACC is prepared to assist the Working Group in assembling anonymized, aggregated performance and structural data from our members, which include credit rating agencies, accounting firms and other data firms that have pre-existing data confidentiality agreements and the necessary safeguards to maintain the anonymity of confidential data.

## II. Using the Summary to inform the Working Group's future work (question 1)

The Summary answers the threshold question of where insurer ABS exposure sits, and it should guide how the Working Group allocates finite modeling resources. Insurers reported $1.61 trillion of ABS on Schedule D, Part 1, Section 2 at year-end 2025, equal to 16.8% of total cash and invested assets of $9.58 trillion. Most of that exposure sits in asset classes that already have established modeling or calibration: agency RMBS and CMBS account for 27.3% of reported ABS, non-agency RMBS and CMBS, which are subject to NAIC financial modeling for designation purposes, for 24.6%, and CLOs, CBOs and CDOs, now subject to modeled CLO C-1 factors, for 19.6%.

### The Summary sizes two of the three priority groups

- **Lease-backed securities:** The four non-financial ABS lease-backed reporting lines total $78.9 billion, or 4.9% of reported ABS and 0.8% of total cash and invested assets. A further $7.2 billion of collateral coded as other leases or real estate leases appears on other non-financial and other financial ABS lines.
- **Individual obligations:** Collateral coded as individual obligations totals $92.0 billion, or 5.7% of reported ABS and 1.0% of total cash and invested assets. Of that amount, 90% ($83.0 billion) sits on a single line, Other Financial ABS, Self-Liquidating (Unaffiliated), which staff observes consists principally of automobile, consumer loan, credit card and student loan ABS.
- **Fund finance:** Staff observed fund finance holdings on lines totaling $434.8 billion, including the two CLO, CBO and CDO lines ($315.8 billion) and five other financial ABS line items ($119.0 billion). The Summary does not isolate fund finance within any of these lines, so the size of the exposure cannot be determined from the Summary.

## III. The three priority asset types (question 2)

The ACC supports a targeted, sequenced review grounded in the equal capital for equal risk principle in the Principles for RBC Requirements, which calls for RBC requirements that are consistent in their statistical safety levels and time horizons and that reflect measurable risks, including the mitigating effects of risk management. Three cross-cutting principles should govern the review of all three groups:

- **Identify the comparable attributes first:** For each group, the Working Group should determine the relevant comparable attributes. A defined understanding of the key risk drivers determines what data is needed and prevents the analysis from presuming its outcome.
- **Coordinate across NAIC groups:** Classification questions belong with the Statutory Accounting Principles (E) Working Group, designation practices with the Valuation of Securities (E) Task Force, reporting with the Blanks (E) Working Group and model

governance with the RBC Model Governance (EX) Task Force. The Working Group should build on that work rather than duplicate it.

- **Follow the evidence in both directions:** The review should not assume that an ABS carries more or less risk than a corporate bond with the same NAIC designation. Where the evidence supports lower or higher factors for a segment, that should be acknowledged. The Working Group should test modeled factors against historical experience, so that conservatism in modeling choices does not distort relative factors and steer insurers toward assets with more favorable treatment rather than lower risk.

**The three groups do not reflect how markets organize asset-based finance**

The three groups are defined on different bases. Lease-backed securities describes a contract form, individual obligations describes an obligor type and fund finance describes a borrower type and structure. As a result, the groups overlap, and each combines exposures with fundamentally different risk drivers:

- **Lease-backed securities:** The group combines granular consumer automobile leases, which perform like consumer loans and are modeled statistically, with aircraft, railcar and container leases that depend on residual values and re-leasing, and with data center and credit tenant leases that are effectively single-name corporate credit.
- **Individual obligations:** The obligor type runs across both the financial and non-financial reporting lines. The Summary reports $1.2 billion of individual obligation collateral on the full analysis lease-backed line and $1.6 billion on the practical expedient lease-backed line, and staff observes student loan ABS within the $1.8 billion of individual obligation collateral on the non-financial practical expedient other line.
- **Fund finance:** The group combines lending to funds through subscription and NAV facilities with rated note feeders, which are structured exposures to a single fund's assets and equity. Staff observed fund finance on the CLO, CBO and CDO lines and on five other financial ABS lines, including the $75.8 billion other line it shares with PACE and consumer ABS.

Alternative asset managers, institutional investors and rating agencies organize asset-based finance by the nature of the collateral and the source of repayment. Market segmentations typically separate consumer and mortgage finance, commercial and small business finance, hard assets such as aircraft, containers, railcars and energy assets, and contractual cash flows such as royalties, intellectual property and other financial contracts.[4]

[4] KKR Credit, Asset-Based Finance (Q2 2020), segmenting the market into consumer and mortgage finance, small and medium enterprise finance, hard assets and contractual cash flows, https://www.bvai.de/fileadmin/Themenschwerpunkte/Private_Debt/Leitfaeden_Whitepapers_Studien/KKR_Asset_Based_

Two risk drivers sit beneath these sector labels and determine how an ABS performs under stress. Both map to the reporting architecture the Working Group already uses:

- **Source of repayment:** The first question is whether a security is repaid from the contractual cash flows of a pool of financial assets or depends on the value, use or re-leasing of a hard asset. The principles-based bond definition already draws this line through the financial and non-financial ABS reporting lines, and the full analysis and practical expedient distinction further measures reliance on asset value.
- **Pool composition:** The second question is whether the collateral is a granular, diversified pool of obligors or a concentrated exposure to a single lessee, tenant or fund. Granular pools lend themselves to statistical loss modeling, while concentrated exposures are better assessed through a look-through to the underlying credit.

We recommend that the Working Group organize its prioritization, and any resulting RBC categories, around these two risk drivers and its existing Schedule D reporting lines rather than around groupings the market does not use and the reported data cannot isolate. Our comments on each group below respond to the sequencing the Working Group has proposed and apply this framework within each group.

### A. Lease-backed securities

The ACC supports prioritizing lease-backed securities, with one important qualification: the group is heterogeneous, and the analysis will only be as accurate as its segmentation. The collateral staff identified includes aircraft, railcars, containers, commercial equipment, automobile fleets, data centers, credit tenant leases and ground leases. These securities derive their credit from two distinct sources, the creditworthiness of the lessee and the value of the leased asset at lease end or on default, and the balance between the two determines how a security behaves under stress.

The principles-based bond definition already provides a useful first cut. Securities on the practical expedient lines amortize more than half of their original principal from in-place cash flows, while securities on the full analysis lines rely more heavily on the sale or refinancing of the underlying assets.[5] We recommend the following segmentation:

- **Lessee credit structures:** Credit tenant leases, ground leases and leases to a single highly rated lessee depend principally on lessee credit. A look-through to the lessee's

Finance_-_White_Paper.pdf; Barings, Asset-Based Finance Steps Into the Spotlight (December 2025), dividing the market into residential, consumer and commercial asset finance, https://www.barings.com/fr-fr/institutional/perspectives/viewpoints/asset-based-finance-steps-into-the-spotlight-privatecredit-vwpt.

[5] SSAP No. 26, Bonds, as revised effective January 1, 2025. Under the practical expedient, a non-financial asset ABS meets the meaningful cash flow requirement if it amortizes more than 50% of its original principal from in-place cash flows. Securities that do not qualify are subject to a full analysis that considers collateral price volatility, liquidity, diversification and overcollateralization.

credit, using the corporate bond framework the NAIC already applies, is a sound starting point for these securities.

- **Residual value structures:** Aircraft, railcar, container and equipment pools depend materially on asset values, re-leasing rates and remarketing outcomes. These require collateral value inputs, depreciation curves and stressed haircuts calibrated to each asset type.
- **Structural protections:** Modeling should capture the protections common to lease ABS, including loan-to-value triggers, cash sweeps, liquidity facilities and lessee and asset diversification, which drive tranche-level outcomes as much as the underlying collateral does.

### B. ABS backed by individual obligations

The ACC supports review of consumer ABS on a targeted basis. Ninety percent of the individual obligation exposure in the Summary sits in self-liquidating other financial ABS backed principally by automobile loans, consumer loans, credit cards and student loans. These are among the most transparent assets insurers hold. Public automobile loan and lease ABS are subject to SEC asset-level disclosure under Regulation AB II.[6] All public consumer ABS issuers file monthly distribution reports, and these sectors have performance histories that span the 2008-2009 financial crisis and the 2020 pandemic shock.

We recommend segmenting individual obligation ABS by:

- **Offering type:** Public and Rule 144A transactions with full servicer reporting should be distinguished from privately placed transactions.
- **Borrower credit:** Prime and non-prime pools have materially different loss distributions and should be analyzed separately. S&P Global Ratings reports that subprime auto ABS annualized losses averaged 8.88% in 2025, 60-day delinquencies reached a record 6.18% and recoveries fell to their lowest annual level since 2007, while its subprime composite has grown from seven issuers in 2009 to more than 20.[7]
- **Asset type:** Point-of-sale and marketplace consumer loans, residential solar loans and home improvement loans have shorter performance histories than automobile, credit card and student loan ABS and warrant specific attention.

### C. Fund finance ABS

[6] Securities and Exchange Commission, Asset-Backed Securities Disclosure and Registration, Release No. 33-9638 (September 4, 2014). Asset-level disclosure applies to residential and commercial mortgages, automobile loans, automobile leases, debt securities and resecuritizations. See Morgan Lewis, A Guide to Regulation AB II, https://www.morganlewis.com/pubs/a-guide-to-regulation-ab-ii.

[7] Auto Remarketing, Despite 'mixed year' for subprime, S&P Global Ratings watches auto ABS volume generate another record in 2025, reporting S&P Global Ratings' annual US auto ABS review, https://www.autoremarketing.com/?p=82346.

The ACC questions treating fund finance as a single category for analysis. Fund finance describes the borrower and the structure, not the collateral or the source of repayment. Fund finance is a material and growing allocation, ranging from 1% to 8% of the investment portfolios of the US life insurers Moody's rates,[8] but we have significant reservations about treating it as a single asset type. It encompasses at least three structurally distinct products, each with different risk drivers:

- **Subscription facility securitizations:** These are backed by investors' uncalled capital commitments. Credit depends on the creditworthiness and diversification of the limited partners and the enforceability of capital call rights.
- **NAV-based facilities and collateralized fund obligations:** These are backed by diversified portfolios of fund interests or fund assets. Credit depends on portfolio value, loan-to-value, diversification and cash flow from the underlying portfolio.
- **Rated note feeders:** These issue rated notes and equity to invest in a single underlying fund. Credit depends on the underlying fund's assets, the subordination provided by the equity tranche and structural protections such as cash sweeps and loan-to-value triggers.

These products cannot be assessed with a single model, and the Summary cannot yet size them. Staff observed fund financing, rated note feeder and project finance holdings on the CLO, CBO and CDO lines, which the Summary shows are subject to CLO C-1 factors under the 2026 methodology. We also note that the Statutory Accounting Principles (E) Working Group's agenda item 2026-10 on embedded asset-liability management risk under SSAP No. 26 bears directly on whether multi-collateral and fund-backed structures qualify as bonds, and the Valuation of Securities (E) Task Force is implementing the SVO's authority to challenge filing-exempt ratings.[9] The Working Group's RBC analysis should follow those classification and designation decisions rather than precede them. Finally, for NAV-based facilities, collateralized fund obligations and rated note feeders, the most accurate approach is a look-through to the underlying portfolio combined with recognition of the structure's subordination and protections. That approach is consistent with the equal capital for equal risk principle, the comparable attributes approach the Working Group adopted for CLOs and

[8] Moody's Ratings, Life Insurance, US: Life insurers stay bullish on private credit (June 17, 2025), p. 4, https://d1e00ek4ebabms.cloudfront.net/production/uploaded-files/Sector_In-Depth-Life-Insurance-US-Life-17Jun2025-PBC_1442118-13e5e8a3-b692-4b9c-88d2-d9ed4ece1b4e.pdf.

[9] Dechert LLP, Duration Is Not Destiny: The NAIC's Proposal for Multi-Collateral Structured Credit Investments (September 2026), https://www.dechert.com/knowledge/onpoint/2026/9/duration-is-not-destiny--the-naic-s-proposal-for-multi-collatera.html; Dechert LLP, Rated Note Fund Market Update 2026 (August 3, 2026), https://www.dechert.com/knowledge/onpoint/2026/8/rated-note-funds--not-throwing-away-their-shot.html (describing the SVO discretion amendment adopted in August 2024, the filing-exempt reforms effective January 1, 2026 and the CRP due diligence framework proposed on May 4, 2026).

the overcollateralization-based approach the Life Risk-Based Capital (E) Working Group adopted for collateral loans in June 2026.

## IV. Availability of data and inputs (question 3)

We appreciate the Working Group's decision to ask this question before modeling begins. Our review of available sources shows that the data needed to model each priority group exists, but in very different forms and degrees of accessibility. The Working Group should match its methodology to the data that can actually be assembled for each group, rather than fill gaps with proxy assumptions borrowed from other asset classes.

### Lease-backed securities

Data for lease-backed ABS is substantial but dispersed across rating agencies, servicers, appraisers and lessors:

- **Transaction data:** Rating agency presale and surveillance reports, trustee and servicer reports and third-party cash flow models cover most public and Rule 144A lease ABS.
- **Collateral values:** Aircraft ABS transactions rely on independent appraisals, typically from multiple appraisers, which rating agencies use to derive value and depreciation assumptions. Railcar, container and equipment lessors maintain fleet utilization, re-leasing and remarketing histories.
- **Stress history:** Aviation lease ABS offers a severe and recent stress observation. KBRA has characterized aviation lease ABS as the structured finance sector hit hardest by the pandemic from a credit perspective, and has tracked the payment status of 171 securities across 63 transactions through the recovery.[10] S&P downgraded 61 aircraft and aircraft engine ABS ratings between March and September 2020, and KBRA downgraded 81 aviation ABS bonds in September 2020 alone.[11]
- **Lessee credit:** For credit tenant leases and single-lessee structures, lessee default probabilities can be drawn from the corporate bond model the NAIC already uses.

### ABS backed by individual obligations

Public consumer ABS has the richest data of the three groups:

[10] KBRA, Aviation ABS Payment Status: Behind Schedule (July 7, 2023), https://www.businesswire.com/news/home/20230707010806/en/KBRA-Releases-Research-Aviation-ABS-Payment-Status-Behind-Schedule.

[11] Structured Finance Association, Research Corner: Aircraft ABS Buffeted by COVID-19 Turbulence (October 13, 2020), https://structuredfinance.org/wp-content/uploads/2020/10/SFA-Research-Corner-Aircraft-ABS-Buffeted-by-COVID-19-Turbulence-10.13.20.pdf.

- **Asset-level disclosure:** Regulation AB II requires standardized asset-level data, filed on EDGAR, for public securitizations of automobile loans and leases. Credit card, student loan and equipment ABS are outside the asset-level requirement but report pool-level performance monthly.
- **Performance indices:** S&P Global Ratings publishes a monthly US auto loan ABS tracker covering cumulative net losses, annualized losses, delinquencies, extensions and recoveries by vintage for prime and subprime pools, rating agencies publish comparable indices for credit card and student loan ABS, and KBRA publishes a monthly marketplace consumer loan ABS index tracking annualized net losses and delinquencies.[12]
- **Macroeconomic data:** The Federal Reserve Bank of New York's Consumer Credit Panel and the Federal Reserve's G.19 consumer credit release support stress calibration across credit cycles.
- **Private transactions:** For privately placed consumer asset-based finance, loan tapes, vintage loss curves and servicer reports are provided to investors under confidentiality agreements. Insurers and their managers can make this data available to NAIC staff under appropriate confidentiality protections.

### Fund finance ABS

Fund finance has a substantial performance record, though most of it is held privately rather than disclosed publicly. However, that private data can be assembled efficiently through a structured data request before modeling begins, and we would be willing to work with the Working Group to help collect it. Here are some examples:

- **Loss history:** Fitch reports that defaults and losses on subscription facilities have been very rare and generally tied to fraud, and estimates that institutional investor capital call defaults have historically been close to zero, with high-net-worth investor defaults of up to 1% of commitments in a 2008-type stress. Fitch also notes that public data is limited and that each manager and lender holds its own default records privately.[13]
- **Rating agency surveillance:** KBRA had rated or assessed 181 subscription facilities through year-end 2024,[14] rated 67 collateralized fund obligations comprising 152 tranches between 2018 and 2024,[15] and has reviewed 279 private equity and secondary

[12] KBRA, US Marketplace Consumer Loan ABS Index: July 2026 (August 14, 2026), https://www.kbra.com/publications/fQfwCcRv.
[13] Fitch Ratings, Subscription Finance Primer (February 3, 2023), https://assets.ctfassets.net/03fbs7oah13w/6vm7YWWMKiNGFBgY6MJcbC/c30ea82f308bddb64c6cb486da8d86f0/2023.02.03-FR-Subscription_Finance_Primer.pdf.
[14] KBRA, press release on subscription facility issuance and rating performance (February 20, 2025), https://www.kbra.com/publications/xyvFZBgc.
[15] KBRA, Private Credit: CFO Growth and Performance (March 13, 2025), https://www.kbra.com/publications/fprQNnhh.

NAV loans since 2020, with 95% of rating actions being affirmations.[16] KBRA has also cautioned that viewing subscription facilities as risk-free is overly simplistic, which underscores the value of structure-specific data over generalized assumptions in either direction.

- **Rating methodologies:** Moody's (November 2025) and S&P Global Ratings (September 2024) have each published methodologies for subscription lines that model repayment from the credit quality and diversification of limited partners, using Moody's CDOROM and S&P's CDO Evaluator, respectively.[17] The ACC is prepared to coordinate an anonymized, aggregated data request among our members covering subscription and NAV facility performance, loan-to-value distributions, structural terms and capital call experience, together with comparable data for privately placed lease and consumer ABS. We recommend that the Working Group specify the data fields it needs, so that responses are consistent and comparable, and that submissions be made to NAIC staff or the Academy under appropriate confidentiality protections. Finally, we note that some fund financings would be considered issuer credit obligations under the principles-based bond definition, so any data collection would have to account for that.

## V. Conclusion

The ACC supports the Working Group's review of ABS capital treatment and its emphasis on data, consistent with the Principles for RBC Requirements. We respectfully ask the Working Group to:

- Treat the Summary as a scoping tool only.
- Organize its review around source of repayment and pool composition, mapped to the existing financial and non-financial ABS reporting lines, and treat the three priority groups as a sequencing tool rather than as RBC categories.
- Determine the comparable attributes for each priority group and calibrate any model to the asset class's own default, loss and recovery experience.
- Segment lease-backed securities by lessee credit and residual value risk, using the full analysis and practical expedient distinction as a starting point.

We appreciate the opportunity to comment and look forward to working with the Working Group, NAIC staff and the Academy as this work proceeds.

[16] KBRA, Private Credit: NAV Loans Evolve as Product Goes Mainstream (2026), https://www.kbra.com/publications/WzjcnGdM.

[17] Moody's Ratings, Rating Methodology for Subscription Credit Facilities (November 5, 2025), https://www.fundfinance.com/wp-content/uploads/2026/03/Moodys-Rating-Methodology-for-SCF.pdf; Haynes Boone, S&P Global Publishes Methodology for Rating Subscription Line Facilities (September 4, 2024), https://www.haynesboone.com/news/alerts/sp-global-publishes-methodology-for-rating-subscription-line-facilities.

If you have any questions or would like to discuss further, please do not hesitate to contact us at jkrol@aima.org or Joe Engelhard, Head of Private Credit and Asset Management Policy, Americas, at jengelhard@aima.org.

Sincerely,





Jiří Król
Global Head of Alternative Credit Council

Joe Engelhard
Head of Private Credit and Asset Management Policy, Americas

November 3, 2026

**Mr. Philip Barlow, Chair**
Risk-Based Capital Investment Risk and Evaluation (E) Working Group
National Association of Insurance Commissioners
1100 Walnut Street, Suite 1000
Kansas City, MO 64106-2197

Re: NAIC Analysis of Asset-Backed Securities Reported by US Insurers

*Submitted Electronically*

Dear Chair Barlow:

On behalf of the American Council of Life Insurers (ACLI), thank you for the opportunity to comment on the Risk-Based Capital Investment Risk and Evaluation (E) Working Group's (Working Group) exposure regarding the *Asset-Backed Securities Reported in 2025 Statutory Filings – Schedule D, Part 1, Section 2 – For all Types of Businesses* Summary (Summary). The Working Group requested feedback on how the Summary should inform future work, the three proposed priority areas for asset-backed securities (ABS), and the availability of data and inputs needed to support modeling.

ACLI appreciates the Working Group's thoughtful approach to determining where additional work on ABS may be appropriate. The Summary is a helpful starting point, but it also illustrates the diversity of assets captured within the current ABS reporting categories.

Accordingly, ACLI recommends establishing well-defined groupings before proceeding to modeling: first, identify assets with reasonably comparable economic and credit-risk characteristics; second, identify the risks to be measured; third, the materiality of those risks; fourth, determine what data are available to evaluate those risks; and finally, determine the appropriate modeling approach and whether changes to the RBC framework are needed based on the RBC principles. This risk-first, data-driven sequence is consistent with the C-1 Modeling Framework Flowchart developed by the American Academy of Actuaries (Academy), which begins by assessing whether existing C-1 models address the relevant risks before considering data sufficiency, comparable attributes and the appropriate modeling approach. Our responses to the Working Group's questions follow.

**1. How should the Summary inform the future work of the Working Group?**

ACLI recommends using the Summary primarily to understand what is currently reported within the ABS categories and identify areas that may warrant closer review. ACLI does not recommend using the current reporting categories, without further analysis, to determine how assets should be grouped for RBC purposes.



The American Council of Life Insurers (ACLI) is the leading trade association driving public policy and advocacy on behalf of the life insurance industry. 90 million American families rely on the life insurance industry for financial protection and retirement security. ACLI's member companies are dedicated to protecting consumers' financial wellbeing through life insurance, annuities, retirement plans, long-term care insurance, disability income insurance, reinsurance, and dental, vision and other supplemental benefits. ACLI's 275 member companies represent 94 percent of industry assets in the United States.

The Summary illustrates the breadth of assets captured within individual reporting categories, including consumer finance, commercial financing, leases, CLOs, fund financing, rated note feeders and other exposures. Refining those classifications would help the Working Group focus its efforts.

A few areas, in particular, would benefit from additional clarification.

First, ACLI requests additional information about the source and methodology behind the "Primary ABS Types (SSG Observation)" column to clarify how the observations were developed and the underlying holdings were mapped to those categories. ACLI also requests a clearer crosswalk between the statutory reporting categories and the identified ABS types to support its evaluation of the Summary.

Second, ACLI requests additional information about what is captured within the various "Other" collateral categories. The Summary indicates that those categories include a number of different types of assets. Before using the Summary to set priorities, the Working Group should clarify the composition of those categories and whether the assets within them share comparable risk characteristics.

Finally, ACLI recommends coordinating this effort with related NAIC initiatives and maintaining the current focus on completing the Structured Products Roadmap being advanced through the Working Group. Allowing that process to run its course will provide a more informed foundation for future work in these areas. Accordingly, ACLI does not recommend immediately prioritizing RMBS and CMBS, particularly because the RBC charges for those securities are currently derived from the SVO's modeling results for each security. With respect to middle market (MM) CLOs, ACLI recognizes the NAIC's decision to apply the adopted broadly syndicated loan (BSL) CLO factors to MM CLOs and requests analysis of available middle market data, using appropriate assumptions, to validate the application of those factors and inform any further consideration of the treatment as the broader roadmap advances.

## 2. Comments on the three proposed priority groups

The Working Group has identified three potential priority groups: lease-backed securities, ABS backed by individual obligations, and fund finance ABS.

The three proposed groupings provide one approach to organizing the work. ACLI recommends refining that approach before using the groupings as the initial classification framework because they rely on different organizing principles and may overlap.

Lease-backed securities describe a characteristic of the collateral or financing; individual obligations describe the type of obligor; and fund finance describes a financing arrangement. These differences may create overlapping categories (e.g., a lease-backed security could also be backed by individual obligations) and support further refinement before the groupings are used as a classification framework.

As a refinement of the proposed approach, ACLI recommends developing economically meaningful groupings based on shared risk characteristics. The Working Group could begin with collateral type or generally recognized market segments, such as auto, credit cards, other consumer receivables, commercial receivables, leases, and specialized ABS.

The Working Group could also begin with the relevant risk drivers. Grouping may be appropriate when ABS types share similar collateral characteristics, performance drivers and analytical methodologies. When those characteristics differ materially, a common reporting classification alone may not support grouping the assets together.

Fund finance requires additional analysis before it should be considered for any modeling. The Summary identifies fund financing and rated note feeder exposures within multiple statutory reporting categories, including CLO/CBO/CDO and other financial ABS categories. However, fund finance does not belong in the same analytical framework as more traditional ABS and should be evaluated as a separate asset class. Some fund finance structures have collateral and risk characteristics that differ materially from traditional ABS backed by consumer or commercial receivables. In fact, some collateral and risk characteristics differ significantly for the assets that have been grouped into this broad categorization (e.g., fund finance and rated feeder notes). To that end, it would be helpful first to define fund finance and then determine meaningful groupings based on shared collateral and risk characteristics for further analysis. We view this as a project for the future once the structured securities work is completed.

ACLI recommends focusing less on the labels assigned to the categories and more on whether the categories reflect meaningful similarities in risk. The categories should be granular enough to recognize material differences without creating unnecessary complexity and should align with existing reporting wherever possible.

### 3. Availability of data and inputs to model priority ABS asset types

ACLI recommends approaching the data question by first identifying the relevant risks and the information needed to measure them.

That sequencing matters because ABS encompasses a wide range of assets whose relevant risk drivers may differ. Beginning with readily available data could allow data availability to drive the modeling approach rather than the economics of the assets.

For each asset type the Working Group decides to evaluate, ACLI recommends first identifying the collateral, obligor, structural and performance characteristics that are important to credit risk. The Working Group should then determine what data are needed to measure those characteristics and where those data currently exist.

ACLI recommends that the Working Group consider information already available through statutory reporting, the SVO, insurers, rating agencies and other regulatory sources before determining whether additional data collection is necessary. Member feedback received by ACLI specifically identified SVO information regarding fund finance as one potential source. Once the relevant risk characteristics and available information are identified, the Working Group can consider which analytical approach is appropriate for each asset type if further work is warranted.

The C-1 Modeling Framework Flowchart appears on slide 9 of the Academy's September 8, 2025, presentation, *C1CS Update on CLO C-1 Factors Modeling*, which the Working Group has previously discussed as a framework for evaluating C-1 across asset classes. Where risks are not similar to those addressed by existing C-1 asset models, the flowchart considers data sufficiency, the availability of comparable attributes and the practicality of individual modeling in determining whether to create new factors or model assets individually.

Within this framework, ACLI recommends considering the comparable attributes approach used by the Academy in its CLO work. The approach examines attributes, including ratings, that may be comparable across assets to identify characteristics relevant to evaluating risk and calibrating an appropriate capital

charge. ACLI recommends that comparable attributes be evaluated holistically, recognizing that, in addition to ratings, differences in tail-loss behavior are most relevant when assessing whether sectors share sufficiently similar risk characteristics to be grouped together.

Applying the adopted BSL CLO factors to MM CLOs illustrates the importance of asset-specific analysis within a comparable attributes framework. The Academy's current calibration is based on BSL CLO data, structures and assumptions. ACLI therefore requests analysis of available middle market data, using appropriate middle market assumptions, to validate the application of those factors and determine whether differences in collateral composition, borrower characteristics, structural protections, tranche thickness, liquidity and performance behavior support further refinement of the treatment.

If, after considering existing data sources and relevant analytical references, additional information from insurers is necessary, ACLI recommends that the Working Group limit its requests to clearly identified modeling needs and, wherever possible, align them with information companies already maintain or report.

## Conclusion

ACLI appreciates the Working Group's decision to begin this process by seeking input on both the scope of the work and the availability of data.

ACLI recommends the sequenced approach described above:

1. Identify asset groupings based on reasonably comparable economic and credit-risk characteristics.

2. Identify the risks the framework should capture.

3. Determine what data are available to evaluate those risks.

4. Determine the appropriate modeling approach, considering the materiality of the risks, and whether changes to the RBC framework are needed.

This approach would avoid placing diverse assets into categories too broad to produce meaningful results. ACLI recommends using existing NAIC analysis, regulatory data and industry reporting before duplicating prior work or requesting additional information without an established need. ACLI also recommends considering the Academy's comparable attributes approach when evaluating how identified risk characteristics, including tail-loss behavior, should inform capital measurement. Consistent with this risk-first, data-driven framework, ACLI continues to request analysis of available middle market data, using appropriate assumptions, to validate the application of the adopted BSL CLO factors to MM CLOs and inform any further consideration of that treatment.

ACLI appreciates the opportunity to provide these comments and looks forward to continuing to work with the Working Group and NAIC staff as this effort moves forward.

Respectfully submitted,





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November 4, 2026
**VIA ELECTRONIC SUBMISSION**

Chair and Members
Risk-Based Capital Investment Risk and Evaluation (E) Working Group
National Association of Insurance Commissioners
1100 Walnut Street, Suite 1500
Kansas City, Missouri 64106

**Re: Asset-Backed Securities Reported in 2025 Statutory Filings (Schedule D, Part 1, Section 2) and Related Questions: Request to Defer Category Selection Until the NAIC Establishes a Defensible Sequencing Process**

Dear Chair and Members of the Working Group:

Pinpoint Policy Institute is a nonpartisan, pro-growth 501(c)(4) nonprofit dedicated to free markets, limited government, and the rule of law. We comment on the staff summary titled *Asset-Backed Securities Reported in 2025 Statutory Filings, Schedule D, Part 1, Section 2, For All Types of Businesses* (the "Summary") and the three related questions the Working Group exposed for comment through November 5, 2026 (together, the "Exposure").[1]

The Working Group should select no ABS category for further risk-based capital ("RBC") evaluation until it can first demonstrate that current bond C-1 factors understate risk, that any error is material to solvency, or that RBC is the right tool to correct it. Selecting a target before answering those questions reverses the proper sequence: evidence should come first and category selection second. Under the American Academy of Actuaries' own threshold framework, the burden to justify a more exact RBC determination rests on the party seeking the change, not on the policyholders who would pay for it.[2] The Summary does not establish that risk. While it may be a useful resource to guide classification and further inquiry, it cannot rank assets by risk or replace the evidence the NAIC's own principles require.

If the Working Group proceeds despite the thin analytical record, it should confine the next phase to first applying the Academy's threshold framework, defining coherent asset categories, and explicitly assessing cost/benefit and market-wide effects. That phase should not presume that capital charges must increase.

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[1] NAIC Risk-Based Capital Investment Risk and Evaluation (E) Working Group, *Exposure Cover Question* (Oct. 6, 2026) (30-day public exposure period ending Nov. 5, 2026); NAIC staff, *Asset-Backed Securities Reported in 2025 Statutory Filings, Schedule D, Part 1, Section 2, For All Types of Businesses*.

[2] This is particularly important because the CLO work involved excessively conservative assumptions that, if applied to other asset classes, would result in a sharp increase in risk changes. The NAIC should not materially vary model inputs to reverse engineer outcomes. Where models vary materially across assumptions, such as with the corporate bond factors and new CLO factors, the NAIC should clearly identify each choice, provide an analysis of the implications relative to existing asset classes (e.g., corporate bonds) and put the inputs out for public comment.

**I. The Summary is an inventory, not evidence of RBC miscalibration.**

The Summary can help the Working Group identify reporting categories that need clarification, surface classification problems, and frame questions for market participants, all of which is useful and informative work for insurance regulators.

However, that is the limit of the Summary's utility for the purpose of this workstream. It cannot support sequencing of RBC review based on true risk assessment; reported balances show the size of an exposure, not its risk, and are dependent on accuracy of NAIC staff assessments of insurer filings. The NAIC's own RBC Principles draw the line: materiality turns on whether an update could meaningfully improve the regulator's assessment of solvency risk, not on whether a category is large or growing.[3] A large asset class with adequate RBC charges is does not pose an urgent solvency gap, and the NAIC has yet to demonstrate empirically that any ABS category poses a material risk to insurer solvency by virtue of inadequate capital charges. While regulators always have the right and the responsibility to review RBC charges, the NAIC's work on ABS charges has been infected by problems with foregone conclusions, aided by skewed model assumptions. This has been evident going back to the initial interim charge placed on residuals in the absence of any significant analytical work, a problem that is not improved by constructing an excessively conservative model to justify a predetermined outcome.

Size of an asset class does not equate to risk, and a large asset class that already carries an adequate charge does not pose a risk to insurer solvency. The NAIC should develop a mechanism to assess the adequacy of RBC charges to protect insurer solvency, not decide that charges are inadequate and develop models retrofitted to justify this conclusion. The Working Group should demonstrate a solvency risk posed by ABS subcategories first, then proceed to modeling work.

**II. The Working Group should apply its stated framework before choosing a target.**

The Exposure does not demonstrate that the Academy's C-1 Modeling Framework Flowchart was applied before the three groups were identified.[4] That framework opens with key threshold questions, asking whether an asset class is materially relevant across the industry, whether the risk is one C-1 is meant to measure, whether existing factors can be used, whether added precision justifies the cost and complexity, whether comparable attributes exist, and whether the data support tail risk modeling. Where a risk is better addressed by another supervisory tool, such as Own Risk and Solvency Assessment (ORSA), asset adequacy testing, disclosure, or examination, the Academy's structured securities principles direct regulators to consider that tool rather than default to a new capital charge.[5]

The NAIC's own emerging model governance framework echoes the Academy's framework. The draft Aspirational RBC Model Risk Management Guidelines, exposed on October 8, 2026, call for a clear model purpose, reliable data, documented assumptions, validation, impact assessment, and an assessment of incentives before RBC is used to address a risk.[6] Launching a new ABS workstream before applying those safeguards would make the governance framework retrospective

[3] NAIC, *Risk-Based Capital Preamble* § G, *Principles for RBC Requirements*, including Principle 3 (Materiality), Principle 4 (Equal Capital for Equal Risk), and Principle 5 (Objectivity) (revised Preamble adopted June 18, 2026).

[4] American Academy of Actuaries, *Principles for Structured Securities RBC* and *C-1 Modeling Framework Flowchart*, materials presented to the NAIC Risk-Based Capital Investment Risk and Evaluation (E) Working Group.

[5] American Academy of Actuaries, *Principles for Structured Securities RBC*, *supra* note 4.

[6] *Draft for Discussion: Aspirational Risk-Based Capital Model Risk Management Guidelines*, prepared with Bridgeway Analytics and exposed by the RBC Model Governance (EX) Task Force on Oct. 8, 2026 (comments due Nov. 1, 2026).

rather than governing. The completion of CLO factors should not lead inevitably to modeling new charges for other assets – it should lead to a determination that such work is necessary and an agreement on timeline, where public comment will be required, and how and when final decisions will be made.

These are threshold questions, not tasks to complete after a category has acquired regulatory momentum. The Exposure answers none of these questions, instead presenting three broad groups without a solvency problem statement, a materiality finding, or evidence that current treatment understates risk.

The Working Group should therefore publish a timeline that includes a process for prioritization before it selects anything. Prioritization should rest on two transparent criteria, each measured on consistently classified data: (1) solvency-based materiality, and (2) empirical evidence that current treatment does not capture the risk, as distinct from growth in holdings, with specific reference to the inadequacy of other supervisory tools. If another supervisory tool fits the identified risk better, the NAIC should use that tool rather than default to a new capital charge.

**III. Build the process and keep commissioners accountable.**

A durable process does not require a new committee. It requires discipline. Before the Working Group changes any ABS treatment, it should:

- publish the specific solvency problem it means to solve and the evidence behind it;
- open supporting materials to public scrutiny and expose each material choice for comment before the decision becomes final;
- weigh costs, benefits, alternatives, and market-wide effects before it acts. The Capital Adequacy (E) Task Force's procedures treat impact analysis as "preferred" for a factor change. For a change of this magnitude, the analysis should be required, performed, and published before any new ABS factor is proposed;[7] and
- keep commissioners accountable for each material judgment, rather than let technical groups, staff, consultants, or model assumptions settle policy by default.

Technical work should inform commissioner decisions, not make them. Pinpoint therefore renews a recommendation made in its November 1, 2026, comment letter to the Risk-Based Capital Model Governance (EX) Task Force.[8] Every material RBC workstream, this one included, should receive at least annual review by commissioners whose own staff are not participating in it. Independent reviewers can test whether the original solvency problem remains established, whether the project remains within scope, whether the process safeguards were followed, and whether continued work is justified.

[7] NAIC, *Procedures of the Financial Condition (E) Committee's Capital Adequacy Task Force in Connection with Proposed Amendments to Risk-Based Capital Blanks and Instructions*, https://content.naic.org/sites/default/files/inline-files/rbc_procedures07172024_without%20Track%20changes.pdf.

[8] Pinpoint Policy Institute, final draft comment letter to the Risk-Based Capital Model Governance (EX) Task Force regarding the proposed Financial Policy Steering Function, revised list of RBC gaps, and Aspirational RBC Model Risk Management Guidelines (Nov. 1, 2026) (recommending independent review of material RBC decisions by commissioners not involved in the underlying decision).

**Requested actions.**

Pinpoint supports a disciplined, evidence-based RBC framework. The Working Group can select nothing now and lose nothing. A defined solvency problem, answers to the threshold questions, a public assessment of costs and market effects, and independent commissioner review all belong before category selection, not after.

Pinpoint respectfully asks the Working Group to:

- Publish a workplan, timeline, solvency-based problem statement, materiality finding, and sequencing criteria before any selection of an ABS subcategory to review.
- Apply the Academy flowchart in writing to each proposed group, and explain why RBC, rather than any other supervisory tool, is required to address sector-side solvency concerns that are supported by empirical evidence.
- Validate the first-year Schedule D, Part 1, Section 2 data and adopt a risk sensitive taxonomy before modeling begins.
- Publish the data inventory, model specification, validation plan, assumptions, sample composition, sensitivity results, and the required market and consumer impact analysis.
- Use any technical forum only with balanced participation, disclosed conflicts, open and transparent materials, public exposure, and regulator accountability.
- Keep existing bond C-1 factors for ABS not selected or not yet reviewed, with no punitive residual or "all other" charge based solely on lack of review.
- Re-expose the matter before selecting a category or proposing any factor change.

The Working Group's objective should be accurate capital, not more capital by default. A disciplined process protects policyholders, preserves productive financing, and strengthens confidence in the state-based insurance regulatory system. The present record is not sufficient to select a target; the Working Group must build the evidence and the safeguards first.

Respectfully submitted,

Eric Ventimiglia

**Eric Ventimiglia**
Executive Director
Pinpoint Policy Institute



October 23, 2026

Philip Barlow
Chair, Risk-Based Capital Investment Risk Evaluation (E) Working Group
National Association of Insurance Commissioners

Re: CLO Model documentation

Dear Chair Barlow:

On behalf of the C1 Subcommittee of the American Academy of Actuaries,[1] I would like to offer the attached report documenting our CLO Modeling work to date. We anticipate providing an addendum for additional sensitivity testing in the near future.

If you have any questions or would like to discuss this report further, please contact Marie Fabienne Amisial, life policy project manager (amisial@actuary.org).

Sincerely,

Stephen Smith, MAAA, FSA, CFA
Chairperson, C1 Subcommittee
American Academy of Actuaries

[1] The American Academy of Actuaries is a 20,000-member professional association whose mission is to serve the public and the U.S. actuarial profession. For 60 years, the Academy has assisted public policymakers on all levels by providing leadership, objective expertise, and actuarial advice on risk and financial security issues. The Academy also sets qualification, practice, and professionalism standards for actuaries in the United States.

Attachment E

OCTOBER 2026

# Model Construction and Development of RBC C-1 CLO Factors

A report prepared for the NAIC by
American Academy of Actuaries
C-1 Subcommittee

American Academy of Actuaries

actuary.org

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The American Academy of Actuaries is a 20,000-member professional association whose mission is to serve the public and the U.S. actuarial profession. For 60 years, the Academy has assisted public policymakers on all levels by providing leadership, objective expertise, and actuarial advice on risk and financial security issues. The Academy also sets qualification, practice, and professionalism standards for actuaries in the United States.

*This paper was developed thanks to the work of the Academy's volunteers. To learn more about becoming a volunteer, please visit actuary.org/volunteer.*




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**October 2026**

Any references to current laws, regulations, or practice guidelines are correct as of the date of publication.




October 2026

# Model Construction and Development of RBC C-1 CLO Factors

## A report prepared for the NAIC by the American Academy of Actuaries' C-1 Subcommittee

## Executive Summary

This paper presents the methodology developed by the **American Academy of Actuaries**[1] **(Academy)** C-1 Subcommittee for estimating **risk-based capital (RBC) C-1** Factors for **collateralized loan obligation (CLO)** debt and equity tranches held by U.S. life insurance companies.

C-1 Factors are promulgated by the **National Association of Insurance Commissioners (NAIC)** and are a component of **RBC.** RBC is an estimate of an insurance company's risk and indicates the minimum level of surplus required to remain solvent in a tail scenario. C-1 Factors specifically approximate credit risk on invested assets.

CLOs are **structured financial products** that pool together loans and repackage the risks to investors through **tranching**. Accordingly, they present distinct analytical challenges relative to corporate bonds. Losses at the tranche level are a nonlinear function of collateral credit performance, especially in tail risk scenarios. Structural features of a CLO (attachment and detachment points, reinvestment periods, coverage tests, etc.) cause severity-given-loss to vary across deals and across tranches. These factors make it inappropriate to apply corporate C-1 Factors directly to similarly rated CLO tranches.

Starting in 2022, the NAIC Structured Securities Group (SSG) developed its own model for C-1 Factors that relied on Moody's CDOnet to project cash flows for individual CLO deals without accounting for CLO security ratings. Conversely, current (pre-2026) bond factors are assigned by credit rating,[2] as derived from a credit analysis performed by the American Council of Life Insurers (ACLI) and Moody's Analytics (MA). The Academy seeks to reconcile these two approaches by incorporating the ACLI/MA bond model (ACLI/MA Bond Model) and only making adaptations where CLOs fundamentally differ from bonds.

When developing and proposing C-1 Factors for an asset class, the Academy posits that new factors should only be applied to asset classes whose risk profiles are fundamentally dissimilar from existing

[1] The American Academy of Actuaries is a 20,000-member professional association whose mission is to serve the public and the U.S. actuarial profession. For 60 years, the Academy has assisted public policymakers on all levels by providing leadership, objective expertise, and actuarial advice on risk and financial security issues. The Academy also sets qualification, practice, and professionalism standards for actuaries in the United States.

[2] Factors are assigned by NAIC designation which, for both corporate bonds and CLOs, typically follows the credit ratings through the filing-exempt process.

modeled asset classes (e.g., corporate bonds). Then, it must be determined if sufficient data exists to model those unique risks. Finally, it must be determined if comparable attributes can adequately summarize an asset's risk level within an asset class without individual modeling. A **comparable attribute** is an easily calculated and easily verifiable attribute of an asset. For example, credit ratings (from Moody's, S&P, etc.) are used as comparable attributes for corporate bond C-1 Factors since credit ratings are widespread, verifiable, and explanatory.

Because CLO tranching creates a distinct risk profile from corporate bonds and because the underlying loans serving as collateral are well documented with robust data, the Academy concludes that modeling C-1 Factors is feasible. The Academy proceeds with several guiding principles, including: proposed factors should materially improve the ability to **identify weakly capitalized insurers;** factors should reflect the **impact of statutory accounting principles (SAP);** and **equal risks should receive equal treatment.**

The approach developed by the Academy accomplishes these goals through four integrated steps: (1) modeling collateral credit risk consistent with the corporate bond methodology, (2) projecting CLO cash flows with CDOnet, consistent with SSG modeling, (3) converting tranche-level tail losses into C-1 capital factors via a 90$^{th}$ percentile CTE estimate (Raw C-1 Factors), and (4) identifying comparable attributes that drive **"Modeled C-1 Factors."**

The collateral modeling inherits the framework used for bond C-1 Factors. The Academy adopts the same default rate assumptions by issuer rating and the same default correlation assumptions. The bond model assumes a **Gaussian copula distribution** with **10% correlation** in defaults. As sensitivity tests, the Academy considered the impact of utilizing a Clayton copula and the impact of changing the correlation assumption to 5% or 20%. Such changes would have dramatically changed the C-1 Factors adopted for bonds,[3] so the Academy retained the same methodology to avoid discrepancies in assumptions.

Four primary changes were made from the bond model. First, **the Academy removed the economic state component** from recovery rates. In the bond model, a Markov chain is used to simulate expansionary and contractionary economies, within which different recovery rate distributions are used. The Academy finds that this component of the model has a negligible impact on the final C-1 Factors for bonds and does not justify the extra model complexity. Second, **the Academy uses recovery rate distributions specific to loans** since loan recoveries are generally higher than bond recoveries due to seniority protections. Two distributions are used, one for senior loans and another for non-seniors. Third, **the Academy models the full loan universe at once** while the bond model derives base factors by rating. Cross-rating diversification is critical to CLO modeling since CLOs reduce risk in senior tranches through diversification. Fourth, the bond model simulates 10,000 scenarios and derives C-1 from the 96$^{th}$ percentile. The Academy runs 10,000 simulations but identifies 17 tail scenarios (90$^{th}$ percentile to 99.99$^{th}$ percentile) to estimate the **conditional tail expectation beyond the 90$^{th}$ percentile (CTE90).**

The resulting simulated defaults and recoveries are passed through CDOnet, which generates cash flows based upon modeling assumptions and specific CLO deal documentation (on rules for reinvestment, overcollateralization tests, etc.). The resulting cash flows are used to estimate maximum post-tax deficiency for each CLO as a proportion of 2024 year-end balance. Each security has 17 modeled C-1 Factors which are averaged together using **Riemann sums** to estimate the average risk beyond the 90$^{th}$ percentile. These averages for each CLO constitute the Raw C-1 Factors.

Modeled C-1 Factors are determined **through an ordinary least squares (OLS) framework**. By regressing Raw C-1 Factors at the security level against comparable attributes, average Modeled C-1 Factors can be derived from model coefficients. Through statistical testing, the Academy concludes that **credit**

[3] For example, see Appendix B where an increase to 20% correlation more than doubles the estimated C-1 Factor for some lower-rated corporate bond categories.

**ratings** (i.e., from S&P, Fitch, Moody's, KBRA, and DBRS) provide material information about an asset's tail risk. Additionally, for CLO debt tranches rated Baa3 and below, **tranche thickness** (defined as the difference between detachment and attachment point) provides additional information about tail risk. Finally, the Academy concludes that tail risk decreases as CLOs approach maturity.[4]

To maintain consistency with the ACLI/MA Bond Model, the Academy's approach normalizes all securities to have an average time remaining in the reinvestment period, thus making C-1 Factors **horizon-neutral.** Additionally, the Academy observes that initial Modeled C-1 Factors do not increase monotonically for CLOs rated A3 and above, due to limitations of data credibility (specifically, lack of heterogeneity in the endogenous factors). For A3 securities, the Academy uses **Akaike Model Averaging** to credibility-weight competing model outcomes. For A2 and above, the Academy applies an **isotonic regression** to force monotonicity and resolve credibility concerns.

The most subordinate component of a CLO is the equity tranche, also called the **residual tranche**. The equity tranche is not entitled to scheduled cash flows but experiences levered returns from excess net income produced by the underlying loans. Under the **practical expedient** approach to accounting for residual tranches, SAP requires insurers to treat cash flows as principal payments, thus reducing book value. From an accounting standpoint, reductions in book value are conservative because they reduce total asset value and, consequently, reduce capital and surplus (assets minus liabilities). An alternative method called **allowable earned yield** operates similarly except that it requires only a portion of cash flows to be treated as principal payments, with the rest treated as income.

Consistent with the guiding principles, the Academy accounts for SAP and models both practices from the cash flows produced by CDOnet. The Academy ultimately elects to use practical expedient accounting for final factors because it depends on fewer modeling assumptions, which leads to more credible results. The current post-tax C-1 Factor for residual tranches is 35.55%. Also consistent with guiding principles, the Academy concludes that the modeled factors do not significantly deviate from 35.55%, so **no change is recommended** (only significant changes with high confidence justify modifications in factors).

[4] CLO practitioners have advised that this relationship may be backwards. They advise that the market treats CLOs with a longer remaining reinvestment horizon as less risky because the CLO manager can offset poor credit experience through active management and buying loans at a discount. The Academy model is structurally not designed to capture this effect because it assumes all loans are purchased at par and does not account for any value created from active management by the CLO manager.

The resulting CLO after-tax C-1 Factors are:

| Rating | Proposed After-Tax C-1 Factors | |
|---|---|---|
| | Thickness > 4% | Thickness ≤ 4% |
| Aaa | **0.03%** | |
| Aa1 | **0.04%** | |
| Aa2 | **0.04%** | |
| Aa3 | **0.04%** | |
| A1 | **0.14%** | |
| A2 | **0.14%** | |
| A3 | **0.80%** | |
| Baa1 | **1.81%** | |
| Baa2 | **2.70%** | |
| Baa3 | **2.73%** | **12.52%** |
| Ba1 | **12.59%** | **22.39%** |
| Ba2 | **20.93%** | **30.72%** |
| Ba3 | **23.28%** | **33.08%** |
| B1 | **26.04%** | **35.84%** |
| B2 | **35.20%** | **44.99%** |
| B3 | **47.32%** | **57.12%** |
| Caa1 | **48.12%** | **57.92%** |
| Caa2 | **55.20%** | **64.99%** |
| Caa3 | **70.82%** | **80.61%** |
| Residual Tranche | **35.55%** | |

The Academy also models a **portfolio adjustment factor (PAF)** for CLOs. Within the bond C-1 framework, base factors are scaled by PAF, which is calculated from the number of unique issuers. In concept, this represents the increased risk of asset concentration (conversely, the reduced risk from issuer diversification).

Due to modeling limitations, the Academy was unable to model PAF directly for CLOs. But consistent with the goal of equal treatment for equal risks, the Academy calculates PAF based on the diversification of underlying collateral. The Academy's proposed base CLO factors are derived from an analysis of the full CLO universe, so any actual portfolio of CLOs will be *less* diversified than the base C-1 Factors indicate.

To estimate an appropriate PAF, the Academy first identifies the full-universe PAF—the PAF that would be applied to an insurer who owns the entire universe of loans underlying the modeled CLOs. Then, the Academy samples sub-portfolios of CLOs (e.g., a portfolio containing two CLOs, three CLOs, four CLOs, etc.) and estimates the distribution of unique loan issuers within each sub-portfolio and estimates the distribution of the corresponding PAFs. Because unique CLOs invest in many of the same underlying loan issuers, adding CLOs to a portfolio increases diversification at a decreasing rate. For each sub-portfolio of CLOs, the Academy estimates **relative PAF** as the ratio of sub-portfolio PAF to full-universe PAF and identifies the median value.

The following factors are recommended:

| # of Unique CLOs | **Proposed Portfolio Adjustment Factor** |
|---|---|
| 1 | **1.3907** |
| 2 | **1.2222** |
| 3 | **1.1586** |
| 4 | **1.1254** |
| 5 | **1.1060** |
| 6 | **1.0926** |
| 7 | **1.0831** |
| 8 | **1.0760** |
| 9 | **1.0704** |
| 10 | **1.0661** |
| 11+ | **1.0000** |

The Academy **alternatively recommends a PAF of 1.0** for all insurers. The first guiding principle of the analysis is that the purpose of RBC is to identify potentially weakly capitalized insurers. By analyzing 2024 year-end statutory filings, the Academy observes that insurers who own six or fewer CLOs are either invested solely in Aa3 and above CLOs (for which the PAF adjustment would *at most* increase factors by 0.01%) *or* have 1% or less of total assets invested in CLOs. PAF quickly plateaus to 1.0, so any additional granularity would have a *minor impact* on required capital, industry wide.

Finally, the Academy analyzes the impact of proposed factors on regulatory arbitrage. An ongoing concern is that a loan portfolio could be restructured into a CLO and an insurer owning every tranche of the CLO (i.e., the **vertical slice**) could receive a lower average C-1 Factor than if they owned the same loans directly (despite retaining the exact same risk). The Academy finds that on average the **proposed factors do not create regulatory arbitrage.**

Differences in loan factors and CLO factors are explained by two factors: conservative statutory residual tranche accounting and PAF. Because SAP requires reduction in book value for residual tranches of CLOs but not for loans, a vertical slice CLO will have *less total asset value* for an insurer than would the full portfolio of underlying loans. Furthermore, the underlying loan pool is well diversified across issuers, so the base factors for loans must be adjusted by the corresponding PAF to create an apples-to-apples comparison. The proposed vertical slice CLO C-1 Factors are lower than a simple average of bond C-1 Factors for the underlying loans, but this is **fully explained** by **the reduced asset value** and **issuer diversification benefit.**

# Acknowledgments

**ACLI**—for use of the C-1 corporate bond model developed by Moody's for ACLI

**Moody's**—for access to CLO deal data, collateral data, historical default rate data, CDOnet, and discussions with credit and insurance professionals

**S&P**—for historical recovery data and discussions with insurance and structured finance analytical professionals

**Bridgeway Analytics**—for discussions on credit modeling, structured finance, and help in understanding the ACLI & Moody's corporate bond model

**NAIC staff at SSG**—for hands-on modeling advice and running CDOnet

**NAIC accounting staff**—for guidance on CLO statutory accounting and reporting

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# 1 Introduction

Risk-based capital (RBC) is a regulatory framework established by the National Association of Insurance Commissioners (NAIC) that requires insurance companies to hold a minimum level of capital in proportion to the riskiness of their assets and liabilities. RBC metrics are used to monitor insurer solvency and identify companies potentially at risk of insolvency. C-1 (asset default risk) is the component of the RBC formula that captures the risk of loss from invested asset defaults or market value declines. Required base capital charges are applied at the asset level based on factors that vary by asset class and credit quality. Additional factors are applied to account for issuer diversification and concentration.

The current framework for C-1 bond factors for fixed income securities was initially implemented in 1994, based on default experience from 1970–1990. These factors remained in place for over two decades before the American Academy of Actuaries (Academy) C-1 Working Group undertook a formal effort to modernize them. The Academy published an initial proposal in August 2015[5] and followed with an updated recommendation in October 2017. These proposals were revised multiple times through 2021 in response to stakeholder feedback and the signing of the Tax Cuts and Jobs Act in 2017 (TCJA), with adjustments including updates to the discount rate and the corporate tax rate assumption (from 35% to 21%).

The American Council of Life Insurers (ACLI), in conjunction with the NAIC, commissioned Moody's Analytics (MA or Moody's) to develop an independent set of C-1 bond factors. In February 2021, MA assessed the Academy's proposed revisions, and by April and May 2021, MA published its formal report: "Revisions to the RBC C-1 Bond Factors."[6] The credit model used to derive such C-1 bond factors (the ACLI/MA Bond Model) uses Moody's historical default rates (1983–2020) and recovery rates (1987–2020), a Markov-chain economic state transition matrix, a Gaussian copula with 90% idiosyncratic and 10% systematic variance, a 96th-percentile value-at-risk (VaR96) risk metric, and a 2.74% post-tax discounting assumption. The model also assumes a "risk premium" equal to half a standard deviation above the mean of the present value of losses. This is roughly equivalent to assuming that an insurance company's reserves are sufficient to cover a 70$^{th}$ percentile loss (discounted to present value) on any given security; the RBC charge seeks to represent the proportion of additional balance needed to cover a loss up to the 96$^{th}$ percentile.

The ACLI/MA proposal became the adopted set of C-1 bond factors beginning in 2021.

With the bond factor methodology established, attention turned to structured securities, CLOs in particular. The NAIC's Structured Securities Group (SSG) conducted earlier CLO-specific work through its CLO Ad Hoc Group, developing an approach to model CLO tranche cash flows. However, the SSG model is inconsistent with the ACLI/MA Bond Model. The Academy's C-1 Subcommittee (C-1 SC) was charged with building a CLO C-1 modeling framework that preserved the structural integrity of the ACLI/MA Bond Model while adapting it to address the unique characteristics of CLO collateral and cash flow mechanics. The Academy's approach synthesizes key aspects of the SSG model with the modeling framework followed by the ACLI/MA Bond Model.

The Academy's CLO C-1 modeling framework (CLO C-1 Modeling Framework)—outlined in this document—has been developed in close collaboration with the SSG and draws on resources from Moody's Analytics (CLO deal data, collateral data, historical default rates, the CDOnet cash flow engine, and discussions with experts), S&P (historical recovery data and discussions with experts), and Bridgeway Analytics (credit modeling guidance and support in understanding the ACLI/MA Bond Model).

[5] *Model Construction and Development of RBC Factors for Fixed Income Securities for the NAIC's Life Risk-Based Capital Formula*; American Academy of Actuaries; Aug. 3, 2015.
[6] Revisions to the RBC C1 Bond Factors Prepared for the NAIC and the ACLI; Moody's Analytics; April 2021.

A formal description of the CLO C-1 Modeling Framework was presented to the Risk-Based Capital Investment Risk and Evaluation Working Group (RBC IRE) on September 8, 2025.[7] A status update including sensitivity testing was provided to regulators on December 15, 2025,[8] at which point two key milestones had been accomplished: finalizing key model assumptions and identifying the full universe of CLO deals to be modeled. Proposed C-1 Final Factors for CLO debt tranches were presented on March 2, 2026.[9] The proposal for residual tranches and portfolio adjustment factors (PAF) was presented on May 6, 2026.[10] The Academy's proposed base factors were adopted by the Risk-Based Capital Investment Risk and Evaluation Working Group (RBC IRE) on June 23, 2026,[11] while the PAF adjustment was set to 1.0. The same adoptions were then made by the Capital Adequacy Task Force on June 30, 2026,[12] and finally by the Financial Condition (E) Committee on July 8, 2026.[13] Changes are effective for year-end 2026.

# 2 Background on CLOs

A CLO is a structured finance vehicle with two core functions. First, it provides a large, stable source of investor demand for leveraged corporate loans, helping companies access credit. Second, it repackages a diversified pool of loans into securities with different risk/return profiles, so each investor can choose their preferred exposure. The transformation of typically below-investment-grade loans into investment-grade CLO debt tranches is the mechanism for increasing investor demand for leveraged corporate loans. The CLO manager (typically an asset management firm) earns management fees by actively overseeing the portfolio on behalf of investors. The essential mechanism behind the structure is tranching: pooling many loans together and slicing the resulting cash flows so that some investors bear the first losses and earn higher yields, while other investors are protected and earn lower yields.

To accomplish this, a special purpose vehicle (SPV) is created to own the loan portfolio. An SPV is a legally isolated entity that issues multiple classes of debt securities (tranches) plus equity to investors; the proceeds are used to purchase a portfolio of leveraged loans. The portfolio typically includes 200–800 unique assets issued by 100–400 corporations (see Appendix A). The SPV's liabilities (debt tranches plus equity) must equal the value of its assets (the loans plus cash held for distribution or reinvestment). The collateralized loans typically account for ~96% of total CLO face value.

Tranches are stacked from most senior (AAA) to most junior (equity). Senior tranches have the first claim on cash flows and the last exposure to losses. Equity sustains initial losses but has the most upside gain when the underlying loans mature without default. Most leveraged loans pay floating rates (historically, London Interbank Offered Rate, or LIBOR, plus a spread; now Secured Overnight Financing Rate, or SOFR, plus a spread). CLO debt tranches are similarly structured as floating-rate instruments, each paying SOFR plus a spread that is set at issuance and reflects the tranche's credit risk. AAA tranches pay the tightest spread; BB tranches (or lower-rated tranches, if they exist in the structure) pay the widest. The equity tranche receives no fixed coupon—it receives whatever cash remains after all debt tranches are paid (subject to overcollateralization and interest coverage tests as described below), making its return highly sensitive to portfolio performance.

The manager selects loans during a warehouse period before the CLO closes and continues building the portfolio afterward. Loan selection is governed by eligibility criteria written into the CLO indenture,

[7] C1SC Update on CLO C-1 Factors Modeling; American Academy of Actuaries; Sept. 8, 2025.
[8] C-1 Subcommittee Update on CLO C-1 Factors Modeling; American Academy of Actuaries; Dec. 15, 2025.
[9] C-1 Subcommittee Update on CLO C-1 Factors Modeling; American Academy of Actuaries; March 2, 2026.
[10] C-1 Subcommittee Update on CLO C-1 Factors Modeling—Residual Tranches and Portfolio Adjustment Factors; American Academy of Actuaries; May 6, 2026.
[11] Risk-Based Capital Investment Risk and Evaluation (E) Working Group Agenda and Meeting Materials; NAIC; June 23, 2026.
[12] Capital Adequacy (E) Task Force Agenda and Meeting Materials; NAIC; June 30, 2026.
[13] Financial Condition (E) Committee Agenda and Meeting Materials; NAIC; July 8, 2026.

including:

- Minimum loan size and maximum single-issuer concentration
- Minimum/maximum weighted average spread (WAS)
- Maximum weighted average rating factor (WARF)
- Industry concentration limits
- Minimum diversity score

These constraints ensure the portfolio remains diversified and within the risk parameters promised to investors at issuance.

CLOs also have a reinvestment period, typically ~5 years. During this time, principal repayments from loans—and principal recovered during a default—are recycled back into new loan purchases rather than returned to investors. This keeps the portfolio fully invested and extends the period over which equity can earn excess spread. The manager actively trades loans throughout this window. Once the reinvestment period ends, principal proceeds are used to pay down tranches sequentially, starting with the most senior (AAA). This is known as the sequential paydown. The CLO winds down as loans mature or are sold and tranches are retired. The legal final maturity is typically 10–13 years from closing, the date the SPV is legally constituted.

When a loan in the portfolio defaults, the portfolio recovers a fraction of par value. If the total value of the remaining portfolio exceeds principal and interest obligations to the CLO debt holders during the reinvestment period, the recovered amount is reinvested. Otherwise, losses are sustained:

- First, equity absorbs the loss; its net asset value is reduced.
- Once equity is wiped out, losses begin to impair the most junior debt tranche (typically BB-rated).
- Losses continue working up the stack (BB → BBB → A → AA → AAA) as cumulative defaults grow.

**Credit enhancement (CE)** is the amount of the capital structure subordinate to a given tranche. This is formalized through the concepts of attachment and detachment points. A tranche's **attachment point** is the cumulative loss level at which it begins to suffer losses; its **detachment point** is the level at which it is completely wiped out. For example, a BBB tranche with a 12% attachment point and an 18% detachment point begins losing principal only after 12% of the collateral pool has been lost and is fully exhausted when 18% has been lost. The equity tranche always has an attachment point of 0% since it sustains the first dollar lost.

Beyond attachment and detachment points, CLOs are governed by a set of portfolio quality and coverage tests that constrain the manager and protect senior investors. The most important of these are:

**WARF:** A Moody's-derived numerical measure of the average credit quality of the loan portfolio. Higher WARF corresponds to lower average quality. Each rating maps to a numerical factor (e.g., Ba3 ≈ 1,766; B1 ≈ 2,220; B2 ≈ 2,720; B3 ≈ 3,490), and the portfolio WARF is the loan balance-weighted average of these factors. The indenture sets a maximum WARF the manager cannot breach. CLOs generally have a WARF of ~2,800. Other rating agencies maintain comparable measures of collateral credit quality.

**WAS:** The average spread over SOFR earned by the portfolio, weighted by loan balance. A minimum WAS is required to ensure sufficient interest income to pay all tranches.

**Weighted Average Life (WAL):** The weighted average time until loan principal is repaid. A maximum WAL test prevents the portfolio from becoming too long-dated.

**Overcollateralization (OC) Tests:** These compare the par value of the collateral to the outstanding balance of a given tranche and all tranches senior to it:

$$\text{OC Ratio} = \frac{\text{Collateral Par Value}}{\text{Outstanding Balance of Covered Tranches}}$$

Each tranche has its own OC test with a minimum threshold (e.g., AAA OC ≥ 120%). If the test fails, cash that would otherwise flow to junior tranches or equity is diverted to pay down senior tranches until the test is cured.

**Interest Coverage (IC) Tests:** These compare interest income from the collateral to interest due on the covered tranches:

$$\text{IC Ratio} = \frac{\text{Interest Income from Collateral}}{\text{Interest Due on Covered Tranches}}$$

A failing IC test similarly redirects cash away from junior investors toward senior paydown. Together, OC and IC tests act as automatic de-leveraging mechanisms that protect senior investors when the portfolio takes losses.

Cash flows from the loan portfolio are distributed in strict **priority of payments** (the "waterfall"): trustee and administrative fees are paid first, followed by the senior management fee and then interest on the AAA tranche, continuing down through AA, A, BBB, and BB tranches (and below, if they exist). OC/IC cure payments are made if any tests are failing, followed by the subordinate management fee, and finally equity distributions. Principal is paid sequentially (AAA first) after the reinvestment period ends.

A **typical CLO** at issuance has the following characteristics:

| Attribute | Typical Value |
|---|---|
| Collateral type | First-lien senior secured leveraged loans |
| Number of loans | 300–900 |
| Portfolio par size | $400M – $1B+ |
| Weighted Average Rating Factor (WARF) | 2,600 – 3,400 (roughly B/B+ average quality) |
| Weighted Average Spread (WAS) | SOFR + 350–425 bps |
| Weighted Average Recovery Rate | 65–70% |
| Reinvestment Period | 4–5 years |
| Legal Final Maturity | 10–13 years from closing |
| Weighted Average Life at Close | 5–7 years |

Shown here is an illustrative structure:

| Tranche | Rating | Thickness (% of Capital Structure) | Attachment Point | Detachment Point | Spread (SOFR+) |
|---|---|---|---|---|---|
| AAA | AAA | 64% | 36% | 100% | 130 bps |
| AA | AA | 12% | 24% | 36% | 140 bps |
| A | A | 6% | 18% | 24% | 160 bps |
| BBB | BBB | 6% | 12% | 18% | 260 bps |
| BB | BB | 4% | 8% | 12% | 500 bps |
| Equity | NR | 8% | 0% | 8% | NA |

# 3 Modeling Approach

## 3.1 Guiding Principles[14] for Structured Securities RBC

The Academy undertook this project to develop a principled, analytically rigorous framework for determining C-1 risk-based capital (RBC) charges applicable to structured securities, with an initial focus on collateralized loan obligations (CLOs). The methodology described herein was developed in accordance with six foundational principles, each reflecting the Academy's considered judgment about the appropriate role of RBC in insurance solvency regulation and the particular characteristics of structured credit instruments. These principles are the result of iterative edits between the Academy and RBC IRE, with RBC IRE ultimately endorsing the principles as laid out below.

The principles are:

1. The purpose of RBC is to help regulators identify potentially weakly capitalized insurers; therefore, changes that have a small impact on RBC ratios may not justify a change to the RBC formula.

2. Emerging risks require regulatory scrutiny.

3. C-1 requirements reflect the impact of risk on statutory surplus. Changes in accounting treatment will affect RBC.

4. C-1 requirements for a given tranche align with that tranche's risk.

5. C-1 requirements on asset-backed securities (ABS) should treat the collateral as a dynamic pool of assets.

6. C-1 requirements for ABS should be calibrated to different risk measures where appropriate.

Together, these six principles define the analytical boundaries within which the C-1 capital charge model was constructed and ensure that the resulting framework is both technically sound and consistent with the broader objectives of insurance solvency regulation in the United States.

The first principle establishes an important threshold consideration: RBC functions as a coarse regulatory filter designed to identify potentially weakly capitalized insurers, not as a precise measure of economic risk. Accordingly, methodological refinements are only warranted where they produce a material impact on RBC ratios across a meaningful portion of the industry. Changes with limited systemic reach may not justify modifications to the RBC formula, even if they improve precision at the individual company level.

The second principle recognizes that RBC operates within a broader regulatory ecosystem. Tools such as Own Risk and Solvency Assessment (ORSA), asset adequacy testing, actuarial guidelines and supervisory examinations complement the RBC framework and should be considered in tandem when evaluating emerging risks. RBC refinements are intended to address material solvency concerns and should be principle-driven and structurally neutral with respect to prevailing market conditions.

[14] These principles were developed and endorsed by RBC IRE in 2023, prior to the creation of the RBC Model Governance Task Force (MoGo). In the time since, MoGo has established an overarching set of principles to guide not just RBC for structured securities but all of RBC. One of these principles has been cited often during discussions of CLO C-1 Factors, namely "equal capital for equal risk." In the context of the six principles described herein, "equal capital for equal risk" most closely aligns with principle #4.

The third principle anchors C-1 requirements to the statutory accounting framework. Because C-1 capital is designed to protect statutory surplus, the treatment of a given asset must reflect how gains and losses flow through the statutory balance sheet. Assets carried at fair value embed market price volatility directly into surplus, which supports a higher C-1 requirement relative to assets carried at amortized cost. Consistent with this principle, C-1 charges for rated, unimpaired debt tranches are calibrated to expected credit losses only, while residual tranches—which are often held at a carry value well below their net asset value—must also incorporate this conservative accounting.

The fourth principle requires that C-1 charges align with the actual risk profile of each individual tranche. The absence of a rating on the underlying collateral is not, in itself, determinative of the appropriate capital charge; what matters is whether a credit rating provider (CRP) has performed a granular assessment of the collateral pool that is reflected in the tranche rating. This principle guards against both over- and under-capitalization arising from categorical assumptions about collateral quality.

The fifth principle reflects the dynamic nature of managed CLO structures. Unlike static bond portfolios, CLO collateral pools evolve over time as managers reinvest principal proceeds and respond to changing credit conditions. The methodology therefore treats the collateral pool as a dynamic asset base, incorporating the effects of future trading activity across a range of economic scenarios. Importantly, C-1 requirements are not reduced to account for idiosyncratic manager outperformance—capital charges reflect the risk inherent in the asset class, not hypothetical outperformance.

The sixth principle addresses the calibration of risk measures. The risk profile of structured securities differs materially from that of conventional bonds, exhibiting non-linear loss characteristics and pronounced tail risk. The Academy therefore determined that conditional tail expectation (CTE), rather than value-at-risk, is the more appropriate basis for calibrating C-1 requirements for CLOs, as it captures the severity of adverse outcomes in the tail of the loss distribution. While RBC neutrality between a CLO tranche and a direct investment in the underlying collateral pool is a useful reference point, strict neutrality is not a design requirement; a reasonable and defensible relationship between the two is sufficient.

## 3.2 Determining the Appropriate C-1 Modeling Approach

RBC IRE endorsed a framework proposed by the Academy where three threshold conditions must be satisfied for C-1 capital charges to be addressed for a given asset class:

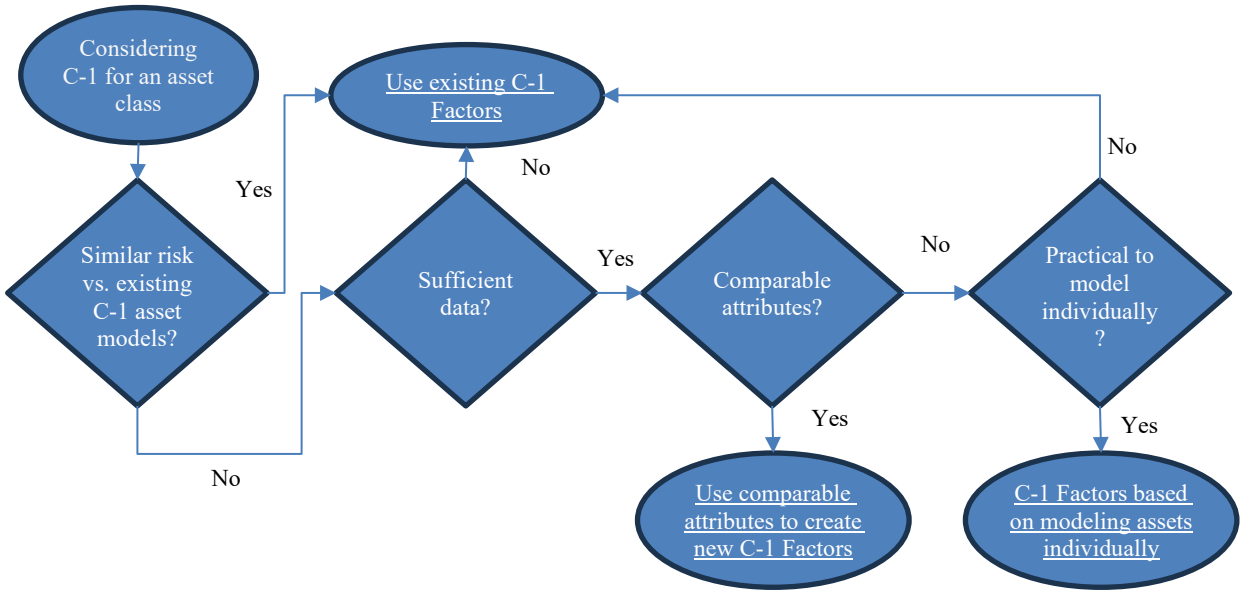
1. The asset class must be sufficiently material in terms of industry-wide insurer allocations to justify the analytical investment;

2. The risks in question must be genuine C-1 credit and solvency risks rather than, for example, illiquidity risk more appropriately addressed through other regulatory mechanisms; and

3. The incremental benefit of developing a tailored methodology must outweigh the operational and regulatory complexity it introduces.

Only when all three conditions are met does the flowchart logic described below proceed to determine the form that modeling should take.

**Figure 1 - C-1 Modeling Flowchart**




The C-1 Modeling Flowchart (Figure 1) poses a sequential series of decisions, each of which narrows the range of appropriate methodological treatments.

The first decision asks whether the risk profile of the asset class under review is sufficiently similar to that of an asset class already covered by an existing C-1 model. Where the answer is yes, the analysis proceeds directly to consider whether the attributes of the new asset class are comparable to those of the existing one. If the risk profile is materially different—as is the case where, for example, tail risk escalates more steeply as credit quality declines—the existing model is not a reliable proxy, and the analysis advances to consider whether sufficient data exist to support the construction of a new framework.

The second decision, reached only when similarity to an existing model has been ruled out, evaluates data sufficiency. C-1 modeling requires an adequate empirical foundation; without sufficiently robust data, risk cannot be reliably calibrated.

The third decision is applicable when an existing model has been ruled out and when this asset class has sufficient data to support a new one. It asks whether the assets within the class share comparable attributes that allow them to be grouped into risk buckets. Where such attributes exist, a factor-based approach is viable: assets are sorted into buckets based on a shared observable characteristic, and a single capital factor is assigned to each bucket. For rated securities, the CRP rating is the natural bucketing attribute, analogous to the designation system used for corporate bonds. For unrated asset classes, proxy metrics may substitute; commercial mortgage loans, for instance, are bucketed using debt service coverage ratios and loan-to-value ratios rather than ratings. Depending on the availability of comparable attributes, the result of this branch may be either the creation of new C-1 Factors or consideration of individual security modeling.

The fourth and final decision applies when neither existing factors nor a new risk-bucket framework can adequately capture the differentiation across assets within the class. Here, the flowchart asks whether individual security modeling is practically feasible. If so, assets are modeled on a deal-by-deal basis, producing security-specific capital requirements. This is the most granular and most resource-intensive treatment, so it is reserved for asset classes whose risk profiles are sufficiently heterogeneous that bucket-

level averaging would produce materially misleading capital signals. Non-agency residential and commercial mortgage-backed securities modeled by the Structured Securities Group represent canonical examples of this treatment. Where individual security modeling is neither practical nor technically feasible, no viable path through the flowchart exists—reinforcing why the threshold cost-benefit condition at the outset is an essential gatekeeping requirement. In such a case, the least bad option is to use an existing set of C-1 Factors. While this will not precisely capture risk, there is no feasible alternative approach that would.

In the case of CLOs, the analysis proceeds along the branch that produces a new set of risk-bucket factors. CLO tranches possess a risk profile that is fundamentally distinct from that of corporate bonds: loss severity in lower-rated tranches is disproportionately high, causing tail risk to escalate non-linearly with declining credit quality. These characteristics are not adequately captured by the existing corporate bond factor schedule, ruling out the first branch of the flowchart. However, the availability of CLO deal and collateral data—along with the analytical tractability of scenario-based cash flow modeling—supports the construction of a new factor schedule, rather than requiring the full operational burden of deal-level individual security modeling. In other words, the Academy seeks to identify comparable attributes and create new C-1 Factors rather than pursuing a framework that requires every security to be uniquely modeled at every RBC reporting date.

# 4 Data

## 4.1 Collateral Data Universe

The collateral data was provided by Moody's Analytics (MA). This data set consisted of all loans that underlie CLOs since 2003. The data was filtered down to observations in Q4 of 2024. MA's database includes snapshots of the collateral at multiple points throughout the year (Run Dates). CLO deals (i.e., the full CLO vertical slice of debt and equity) that were run multiple times in Q4 of 2024 were filtered so that only the most recent Run Date was kept. The resulting data set consisted of:

- 3,016 deals
- 7,702 unique loan issuers
- 1,256,415 collateral assets

This data set includes the following fields:

a) **BALANCE:** The total dollar amount invested in the asset

b) **SECURITY_TYPE:** Type of collateral, by balance:

| SECURITY_TYPE | BALANCE ($) |
|---|---|
| Loan | 1,101,739,982,146 |
| Bond | 66,513,764,479 |
| DDL | 6,533,788,946 |
| RL | 297,299,184 |
| TRUPS | 34,500,000 |
| SN | 25,000,000 |
| SECMKTSP | 20,000,000 |
| Loan Participation | 7,114,308 |
| EQ | 10,416 |
| IO | 161 |

c) **SECURITY_GROUP:** Group of collateral, by balance:

| SECURITY_GROUP | BALANCE ($) |
|---|---|
| Loan | 1,108,571,070,276 |
| Bond | 66,548,264,479 |
| Other | 52,114,469 |
| Equity | 10,416 |

d) **MATURITY:** Date that collateral matures.

e) **SENIORITY:** Loan-level seniority, by balance:[15]

| SENIORITY | BALANCE ($) |
|---|---|
| Sr Sec | 1,135,190,457,127 |
| Sr Unsec | 16,178,288,692 |
| Second Lien | 7,129,316,514 |
| Subordinated Secured | 216,209,645 |
| Sr Sub | 162,528,280 |
| Mezz | 8,845,226 |
| Senior | 7,678,983 |
| Junior | 1,623,571 |
| Jr Mezz | 947,912 |

f) **ISSUER_RATING:** Ratings from Moody's and S&P at the *issuer* level

g) **RATING:** Ratings from Moody's, S&P, and Fitch at the *asset* level

### 4.1.1 Standardizing Collateral Credit Ratings

Collateral credit ratings were processed and standardized to generate a single credit rating input used for collateral default modeling. Issuer rating is selected over asset rating given that the ACLI/MA Bond Model relies on issuer-level ratings. However, this requires preprocessing to address missing data and to address discrepancies between issuer- and asset-level ratings.

At the issuer level, Moody's and S&P ratings are provided. At the asset level, Moody's, S&P, and Fitch are all provided. As shown in the table below, only 87.7% (1 − 12.3%) of line items (weighted by balance) in the collateral have an issuer rating (either Moody's or S&P); 94.9% have at least one rating of the asset and 95.1% have a rating of either the asset or the asset's issuer.

**Table 1 - Missing Ratings for Loans in CLO Collateral**

| | Aggregate Amounts | | Proportion of Total Universe | |
|---|---|---|---|---|
| | Missing Count | Missing Balance | Missing Count | Missing Balance |
| Moody's Issuer Rating | 268,436 | 301,770,262,361 | 21.5% | 25.7% |
| S&P Issuer Rating | 222,886 | 292,184,032,278 | 17.9% | 24.9% |
| Moody's Asset Rating | 59,693 | 111,797,066,545 | 4.8% | 9.5% |
| S&P Asset Rating | 73,728 | 129,876,556,972 | 5.9% | 11.1% |
| Fitch Asset Rating | 633,150 | 609,591,063,311 | 50.8% | 51.9% |
| Both Issuer Ratings | 93,582 | 144,091,822,029 | 7.5% | 12.3% |
| All 3 Asset Ratings | 28,878 | 59,630,883,740 | 2.3% | 5.1% |
| All 5 Issuer and Asset Ratings | 27,767 | 57,914,389,401 | 2.2% | 4.9% |

[15] Some assets do not have a recorded seniority. See Section 4.1.2.

First, the Academy observes that within the 87.7% of line items that have at least one issuer rating, 70.3% have a rating from both Moody's and S&P, and 26.4% have different ratings from the two agencies. In cases where the ratings differ, the lower of the two is assigned to the issuer, in line with NAIC designation assignment procedures.

**Table 2 - Distribution of Assets with at Least One Issuer Rating**

| | Aggregate Amounts | | Proportion of Total Universe | |
|---|---|---|---|---|
| | Count | Balance | Count | Balance |
| Both Issuer Ratings Present | 849,435 | 725,308,977,789 | 73.5% | 70.3% |
| Both Present but Disagree | 330,227 | 272,465,561,216 | 28.6% | 26.4% |

Second, among the 2,901 unique issuers that have two ratings present in the collateral data universe, there are 584 issuers for which at least two assets have issuer ratings (the lower of Moody's and S&P) that differ from one another. The cause of this discrepancy is the Run Date. Each CLO has its collateral recorded periodically and the dates of recording happen at different points throughout the quarter. At least one CLO had its last Q4 2024 Run Date on October 2 and at least one CLO had its last Q4 2024 Run Date on December 31. To account for the cross-CLO discrepancies, the Academy standardizes the issuer ratings by recording only the *most recent* Run Date.

As an example, one issuer appears in the collateral data universe with 284 unique assets held across 139 CLO deals. These CLOs had their collateral recorded on 19 different dates during Q4 of 2024 (from November 5 to December 31). The assets recorded on November 5 have an A- issuer rating from S&P (no Moody's issuer rating). The assets recorded on November 20 or later have an issuer rating of A from S&P (still no issuer rating from Moody's). To standardize the ratings, the Academy looks at the issuer rating on December 31 (A, for the example presented) since that is the most up-to-date data and assigns that rating to all assets from the issuer.

Lastly, the Academy uses asset-level ratings to proxy issuer-level ratings where issuer rating is not available. As shown in the table above, a greater proportion of collateral has asset-level ratings than issuer-level ratings, so the asset-level ratings can be used as a proxy. However, the asset-level ratings and issuer-level ratings do not map 1:1. Because loans are predominantly first lien, they have higher recovery rates than unsecured debt. This can cause an asset to have a higher rating than the rating of its underlying issuer. For example, an issuer rated B by S&P could issue a loan rated B+ because it is senior to the issuer's unsecured debt.

To quantify this, the Academy filters the collateral data to all line items that have both an issuer rating and asset rating. Since there are ratings from three agencies at the asset level, the Academy assigns either the worst of two ratings or the median of three for the asset-level rating (using the worst of two for issuer-level rating). Converting these aggregated ratings to numbers (with Aaa equal to 1, Aa1 equal to 2, etc.), the Academy calculates the average issuer rating for each asset-level rating, weighting by balance. For all ratings B2 and above, the average issuer rating is either the same as or worse than the asset rating. This is consistent with the hypothesis that leveraged loans' issue ratings are on average higher than the issuer rating. Averaging across all asset ratings by balance, the average difference in rating is 0.09. This translates to: for a given asset rating, the issuer rating is on average 9% of a rating worse.

**Table 3 - Distribution of Issuer Ratings per Existing Asset Rating**

| Letter Rating | Asset Rating | Average Issuer Rating | Difference |
|---|---|---|---|
| Aaa | 1 | 1.56 | 0.56 |
| Aa1 | 2 | 2.00 | 0.00 |
| Aa2 | 3 | 3.00 | 0.00 |
| Aa3 | 4 | 4.56 | 0.56 |
| A1 | 5 | 6.34 | 1.34 |
| A2 | 6 | 6.41 | 0.41 |
| A3 | 7 | 7.04 | 0.04 |
| Baa1 | 8 | 8.11 | 0.11 |
| Baa2 | 9 | 9.41 | 0.41 |
| Baa3 | 10 | 10.38 | 0.38 |
| Ba1 | 11 | 11.57 | 0.57 |
| Ba2 | 12 | 12.31 | 0.31 |
| Ba3 | 13 | 13.23 | 0.23 |
| B1 | 14 | 14.08 | 0.08 |
| B2 | 15 | 15.15 | 0.15 |
| B3 | 16 | 15.96 | -0.04 |
| Caa1 | 17 | 16.92 | -0.08 |
| Caa2 | 18 | 17.70 | -0.30 |
| Caa3 | 19 | 18.43 | -0.57 |
| Ca | 20 | 19.02 | -0.98 |
| C | 21 | 18.65 | -2.35 |
| D | 22 | 21.50 | -0.50 |
| | | | |
| Total | 14.79 | 14.88 | 0.09 |

Relying on this conclusion, the Academy groups all asset-level ratings by issuer—for the issuers that do not have any recorded issuer-level rating—and averages together all numeric asset ratings (either the worst of two or median of three). The average is weighted by balance, and the final rating number is set equal to the next whole number above the average. For example, if assets for an issuer are mostly rated B2 with some B1, with an average rating number of 14.8, the next whole number is 15, equivalent to a B2 rating.

For a given loan rating of B3 or lower, the average issuer rating is slightly higher. For example, for loans rated B3, the issuer rating is on average 0.04 notches higher. Despite this observation, the Academy decides to adjust all ratings equally for internal consistency. This results in additional conservatism for loans rated B3 and below for which issuer rating is not available.

### 4.1.2 Standardizing Tranche Seniority Levels

Because loan recoveries depend highly on seniority, the Academy uses one distribution for senior loan recovery rates and another for non-senior loan recoveries. After applying aforementioned filters, 98.3% of balance is senior debt. The remaining 1.7% is mapped to non-senior (including the line items with missing seniority data).

### 4.1.3 Data Exclusions

After standardizing collateral credit ratings, 71.0% of issuers have an assigned rating. This accounts for 97.3% of the collateral balance. Only 180 CLO deals have at least one debt security without any assigned issuer rating. Within these 180 deals, 35.2% of the collateral's balance is unrated. Due to the concentration of missing data in these deals, the Academy elects to exclude them from further analysis.

Of the remaining 2,835 CLO deals, 2,674 are classified as "CDO - High Yield CLO-Arbitrage Cash Flow." The data is further truncated to 2,674 deals to exclude all middle market loans given that the data set only covers a small share of the middle market universe. The remainder of this analysis applies only to

**broadly syndicated loan** (BSL) CLOs.

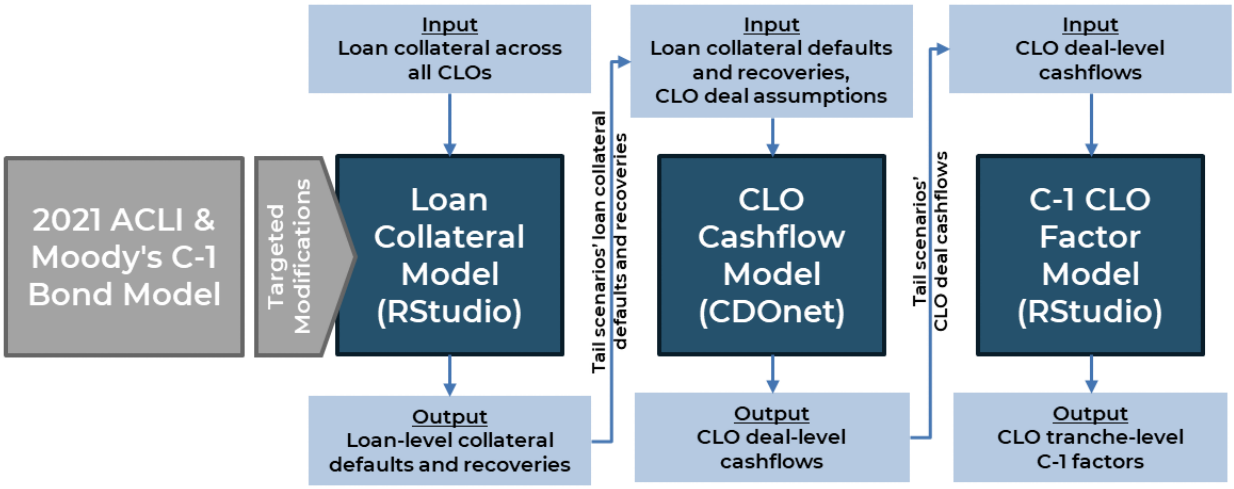
## 4.2 CLO Deal Data Universe

All deal-specific information (on tranche structure, interest and principal payments, reinvestment rules, etc.) is contained within CDOnet, courtesy of Moody's Analytics.

# 5 Assumptions and Methodology

The Academy estimates CLO tranche-level Raw C-1 Factors for the universe of CLO deals held by insurers using a 3-step modeling approach:

**Figure 2 - Raw C-1 Factors 3-Step Modeling Approach**



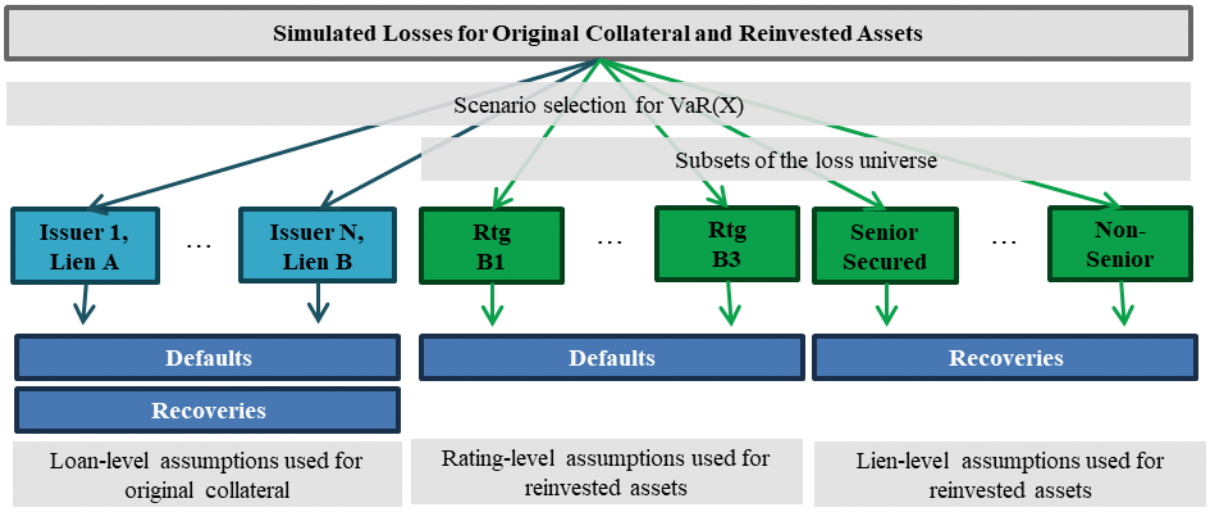

Raw C-1 Factors are unique to each CLO debt tranche. Modeled C-1 Factors are then derived using the Comparable Attributes Modeling Approach.

## 5.1 Raw C-1 Factors

### 5.1.1 Step 1—Loan Collateral Credit Model (Collateral Model)

The purpose of the Collateral Model is to produce loss input assumptions for the CDOnet Cash Flow Model. Assumptions are provided for the original collateral and for the reinvestment collateral. For original collateral, a vector of time-to-default and a vector of loss-given-default are provided for each security. For reinvested collateral, the Academy calculates vectors of default rates by rating and recovery rates by lien.

**Figure 3 - Loan Collateral Model Overview**




The Collateral Model generates 10,000 simulations, consistent with the ACLI/MA Bond Model. The simulations are 10-year loss projections where issuer default and loan recoveries are modeled stochastically for the full collateral universe. Present value (PV) of losses is calculated across the collateral for each scenario. For each scenario, the following assumption vectors are produced:

- For each unique combination of issuer and lien, default and recovery vectors.
- For each rating, default vectors.
- For each lien, recovery vectors.

The default and recovery assumption vectors for the unique combinations of issuer and lien are used for the original collateral present in the CLO deal universe as of Q4 2024. The default assumption vector by rating and recovery assumption vector by lien are used for reinvested assets.

#### *5.1.1.1 Consistency with ACLI/MA Bond Model*

When examining options for modeling collateral risk, the Academy preserved the ACLI/MA Bond Model where possible. However, certain fundamental changes needed to be made up front:

- **Switching from VaR96 to CTE90:** Bond losses are predominantly driven by idiosyncratic risks and their severity is diversified. CLOs, by contrast, suffer no losses until the attachment point is penetrated at which point defaults can quickly approach 100%. As a result, targeting one single percentile (like 96) could underestimate the tail risk for bonds that are first penetrated in a 97$^{th}$ percentile or worse scenario. To account for the fatter tail risk, the Academy concludes that switching from value-at-risk (VaR) to conditional tail expectation (CTE) is appropriate.

- **Removing economic state Markov chain:** The ACLI/MA Bond Model did not assume a constant recovery distribution; instead, it implemented two recovery rate distributions that are chosen by the economic state. The economic states are determined by a Markov chain where the economic state alternates between expanding and contracting (based on fixed conditional probabilities). Due to data limitations on loan recoveries, the economic state model was removed.

- **Sampling full-universe scenarios:** In the ACLI/MA Bond Model, a 96th percentile was chosen for each rating with the number of bonds determined by a representative insurer's portfolio. This approach accounts for diversification within ratings but not across ratings. However, C-1 is supposed to represent a security's contribution to total portfolio risk, not its own individual risk. This is crucial to CLO modeling because the CLO structure accounts for cross-rating diversification.

To quantify the effects of the first two changes, the Academy re-ran the ACLI/MA Bond Model to determine what the bond C-1 Factors would be if these two modeling decisions were made (see Appendix B). When comparing various CTEs, the Academy finds that CTE90 produces bond C-1 Factors most similar to the adopted VaR96 factors. The root mean squared error (RMSE) is 0.1%, indicating that bond factors would move around by a rough average of 10bps should the VaR96 be switched to CTE90. The simple average is a change of 0.01%, meaning that a switch from VaR96 to CTE90 would cause bond C-1 Factors to increase, on average, by only 1bp. It was impractical to quantify the impact of the third change due to computational constraints.

The Academy concludes that the switch from VaR96 to CTE90 better captures the tail risk of CLOs without causing a meaningful deviation from the bond model. Should the NAIC seek consistency across bond and structured factors, bond factors could be re-run with CTE90 without a significant average impact.

Regarding the economic states, re-running the ACLI/MA Bond Model with the assumption that the economic state is always expansionary lowers factors by 7bps on average with an RMSE of 17bps. For investment-grade (IG) bonds, both the absolute average change and RMSE are less than 1bp. The Academy was unable to procure recovery rates by economic states. Because the impact of the economic state assumption is minor in the ACLI/MA Bond Model, the Academy concludes that removing the economic states assumption does not cause the Collateral Model to meaningfully differ from the ACLI/MA Bond Model.

#### *5.1.1.2 Defaults and Recoveries Assumptions*

When modeling collateral risk, the Academy seeks continuity with the ACLI/MA Bond Model. Within that model, **defaults** are randomly sampled based on *issuer* rating (by an agency), using a probability mass function (PMF) by rating and years-from-rating. Moody's provided the PMF to the Academy, along with the accompanying code, written in R.

For **recovery rates**—the amount recovered during default as a proportion of par—the ACLI/MA Bond Model randomly samples rates under a PMF, where the recovery rates are separated into deciles (e.g., a recovery rate of 8% falls into the 0-10% recovery decile). There are 11 buckets since recoveries can fall into the >100% recovery bucket, should interest be recovered in addition to principal. When a bucket is selected via random sampling, the average value of that bucket is assigned as the security's recovery rate.

Since loans have security provisions, their recovery rates systematically differ from the recovery rates for unsecured bonds. The Academy replaced the recovery rate distribution with data provided by S&P in the same format (split into deciles, with a >100% bucket and with average rates per bucket). The Academy distinguishes senior from non-senior loans for the purpose of modeling recovery. These rates are presented in S&P's publication "Recovery Study (U.S.): Quantitative Easing, Low Yields, And Distressed Exchanges Have Boosted Bond Recoveries Since 2010."[16] The recovery rates for senior loans are proxied by Chart 10 ("First-Lien Term Loan Recovery Rate Histogram") and for non-senior loans are proxied by Chart 11 ("Second-Lien And Unsecured Term Loan Recovery Rate Histogram").

The Academy was unable to procure loan recovery rates by decile from Moody's, so S&P data was used

[16] Sign-in required for access.

instead. This could potentially introduce a discrepancy between the CLO Collateral Model and ACLI/MA Bond Model. S&P reports recovery rates as the ultimate amount recovered while Moody's reports recovery rates 30 days after default. Because CLO managers typically sell defaulted loans prior to recovery, this divergence may reduce the model's accuracy.

As a stress test, the Academy constructed a hypothetical distribution of recovery rates such that the average loss given default (LGD) for senior and non-senior loans match the average LGDs published by Moody's; the shape of the distribution was chosen to minimize difference from the S&P distribution using least-squares. The Collateral Model was run on six sample deals (see Appendix K, Sensitivity 5). Although the results are purely hypothetical given Moody's actual recovery rates were not available to the Academy, the stress test shows significant differences in the C-1 Factors.

#### *5.1.1.3 Stochastic Loss Simulations*

Consistent with the ACLI/MA Bond Model, the Academy runs 10,000 simulations that project losses over a 10-year horizon. The seed is set to 1 so that random numbers can be replicated. The full collateral is grouped by issuer. For each issuer, the cumulative probability of default distribution is appended in accordance with the issuer's rating. The default probabilities are identical to those used in the ACLI/MA Bond Model.

To accommodate CDOnet, the default probabilities are geometrically interpolated from year-end probabilities to month-end probabilities. These are then converted into one-month marginal probabilities.

As in the ACLI/MA Bond Model, a Gaussian copula is used with a 10% correlation assumption. In the ACLI/MA Bond Model, this involves sampling a random variable for each year from the standard normal distribution (the systematic risk) and one random variable for each line item and each year (the idiosyncratic risk). A default occurs for line item $i$ if:

$$\sqrt{10\%} \times Z_{systematic} + \sqrt{90\%} \times Z^{i}_{idiosyncratic} \leq \Phi^{-1}(P^{i}_{default})$$

where $\Phi$ is the cumulative distribution function (CDF) for a standard normal variable. This is mathematically equivalent to sampling a default for each line item $i$ with probability $P^{i}_{default}$ because the sum of two normal variables is normal; because the mean for both the systematic and idiosyncratic components is 0; and because the composite variance is $\left(\sqrt{10\%}\right)^2 + \left(\sqrt{90\%}\right)^2 = 100\% = 1$. In the ACLI/MA Bond Model, the defaults are sampled by year rather than month so the systematic components represent annual probabilities. To not over-diversify, the Collateral Model uses the same $Z_{systematic}$ factor for all 12 months in each year but a different idiosyncratic factor for each month. If a loan defaults, the year and month are recorded. Only the time of the first simulated default is recorded—the ACLI/MA Bond Model can simulate multiple defaults per line item since the model assumes that all defaulted bonds are replaced by identical bonds, paid for by surplus.

The Academy considered adjusting the correlation parameter since it may not be the case that loan and bond issuers have the same exposure to systematic risk. Supporting literature shows a variety of correlations and is not conclusive on an appropriate point estimate.[17] Qi et al. found that the correlation parameter ranges from 2% to 10% for B-rated bonds, depending on the time horizon. Meanwhile, Li and Chen found that the correlation for B-rated issuers can range from 2% to 51%, depending on the time horizon.[18] Consistency with the ACLI/MA Bond Model requires that any divergence from the ACLI/MA Bond Model should be justified by statistically significant differences between the bonds typically held by life insurers and loans

[17] "Default Correlation: Rating, Industry Ripple Effect, and Business Cycle"; *Applied Economics*; 2019.
[18] "The Domino Effect of Credit Defaults: Test of Asymmetric Default Correlations Using Realised Default Data"; *Applied Economics*; 2018.

typically held by CLOs. Because the academic literature on cross-issuer correlation is inconclusive, it is implausible that any alternative correlation is better than the ACLI/MA assumption of 10% with statistical significance.

To understand the impact of the assumption, the Academy ran a stress test on the ACLI/MA Bond Model with alternate correlation assumptions (0%, 5%, 20%, and 40%). The Academy found that the results are highly sensitive to this correlation assumption (see Appendix B). The resulting bond factors can change by nearly a factor of two or three when choosing 0% or 40% correlation.

For recoveries, all issuers and seniorities are grouped together. For each combination, one of 11 ranges is selected from the PMF (i.e., 0–10% recovery, …, 90–100% recovery, 100+% recovery) and the average recovery from that range is assigned. This is the same logic as the ACLI/MA Bond Model, except the PMFs and average recovery rates differ between senior and non-senior loans.

Another model simplification is that the senior and non-senior recoveries are sampled independently, even if they share the same issuer. It is expected that the senior loan's recovery rate should always be at least as high as the subordinated tranche recovery rate. When sampling independently, some subordinated tranches will end up with higher recovery rates than the issuer's senior loans.

The Academy chose not to explicitly address this because S&P joint recovery rates were not available. A proxy solution, such as sampling the senior tranche's recovery first and then sampling the subordinated tranches from a truncated distribution, will artificially suppress the average recovery rates. For example, if the senior tranche recovers more than 100% of principal, it is more likely that the subordinated tranche will also fully recover, but the magnitude of this increased likelihood cannot be determined without a joint PMF distribution. Hence, the Academy determined that independent sampling, while theoretically unintuitive, introduces the least additional bias and modeling error.

After the simulation function is run, the resulting data table contains every pair of issuer and seniority with one column indicating the time of default in years (-1 if no default is sampled), another column indicating the recovery as a proportion of par and a final column indicating the simulation number (1 through 10,000).

#### *5.1.1.4 Reinvestment Modeling*

While the losses on *initial* or *original* collateral follow the simulated output, the reinvestment of recovered principal and interest is an important component of a CLO's ultimate risk profile and is not a trivial modeling exercise. The Academy considered five reinvestment methodologies:

1. **Use parametric average loss rates**

   In this approach, all reinvested asset losses are modeled using the parametric average default and recovery rate assumptions.

   **Pros:** This method is the simplest and is the easiest to replicate, as it does not rely on random sampling.

   **Cons:** This method creates a disconnect between the original collateral simulated losses and the reinvested asset losses. The method will understate the tail risk. A tail risk scenario will have above-average losses in both the original collateral and in the reinvested assets. By assigning average losses to the reinvested assets, the tail risk from reinvested assets is ignored.

**2. Stochastically simulate reinvestment losses**

This method would extend the simulation model to the reinvested assets. Within each simulation, the recovered balance would be calculated for each year. New loans would be added to the next year's loss simulation and would be affected by the same systematic risk factor in the copula. Additionally, the time-since-rating would differ between original collateral and reinvested collateral (e.g., in year-3, original collateral is 3 years from rating but investments on year-2 recovered principal will be 1 year from rating). This method would also account for principal recovered on reinvested assets that also default. The losses would then be averaged into vectors that can be read by CDOnet.

**Pros:** This method is the most accurate because it accounts for the fact that reinvested assets are subject to the same systematic risks as the original collateral (which can compound tail risk) and accounts for the fact that reinvested assets will have time-since-rating offset with the original collateral.

**Cons:** This method is too convoluted and computationally expensive. The simpler methods already have extensive run time. This model also creates false precision because it requires assumptions about issuer diversification without knowing the behavior of the actual CLO managers. If the reinvested assets are only new issues (i.e., loans that do not already exist in the collateral's loan universe), this will over-diversify. If the reinvested assets are all issuers contained in the original collateral, it will under-diversify.

**3. Average simulated loss rates, starting at time of reinvestment**

This method takes the simulated defaults and averages them by year and rating. The simulated recoveries are averaged by year and seniority. The simulated amount available for reinvestment would follow these average default and recovery rates starting at *time of reinvestment.* For example, suppose some loans default in year-2 and are reinvested in B1 senior loans in year-3. If the original collateral rated B1 defaulted at a rate of 5% in year-1 and senior loans recovered 40%, then the reinvested B1 senior loans would have a 5% default rate in year-3 (i.e., year-1 from the time of reinvestment) with a 40% recovery rate.

**Pros:** By using the loss rates from the simulations, it reasonably captures tail risk in the reinvestments. By starting the rates from the time of reinvestment, it properly accounts for rating migration. Marginal default rates generally increase in the second year (over the first) and thereafter decrease. Reinvested assets could be riskier because they have yet to experience positive rating migration. By aligning the time-since-rating, this method accounts for that misalignment.

**Cons:** This method creates a misalignment in the systematic risk factors between the original collateral and the reinvested assets. For example, if a large systematic risk is sampled in year-1, then the original collateral will have higher default rates in year-1. This means that all reinvested assets will be assigned this large systematic risk in their first year of issuance, even if the original collateral has less severe systematic risks in all subsequent years. In this case, the year-1 stress scenario is being overstated within the reinvested assets and overstates the risk. On the flip side, if the most severe systematic risk occurs in year-6 for the original collateral, then the reinvested assets may never reach the stress scenario, even if reinvested assets are live in year-6. For example, a new asset purchased in year-5 will in practice experience the year-6 stress scenario, but in this model, the simulation will end before the reinvested asset gets to its own sixth year. This case understates the risk of the CLOs.

4. **Average simulated loss rates, starting at time 0**

   This method is identical to the prior method, except the default and recovery vectors are keyed to time 0 rather than the time of reinvestment. For example, if the original collateral has a stress scenario in year-3, then all reinvested assets in force during year-3 are assigned the same default rate and same recovery rate as the original collateral. In the prior method, the reinvested assets would be assigned the year-3 default/recovery rate after being in force for three years.

   **Pros:** Like the prior method, this is computationally simpler than stochastically modeling the reinvestments. Furthermore, it addresses the con in the prior solution by aligning the systematic risk factors. If a year has a severe systematic risk, that systematic risk affects the reinvested assets as well, rather than being misaligned. This should better reflect the tail risk of a CLO since a CLO is under the most stress when underlying loans simultaneously default.

   **Cons:** This method has a slight mismatch in the ratings due to rating migration. If recovered principal is reinvested into a B1 asset in year-3, the default rates are derived from loans that were rated B1 at the start of year-1, not at year-3. Some of those loans may have experienced rating migration so the year-3 default rates do not reflect a newly rated B1 loan.

5. **Average simulated loss rates, starting at time 0, expected ratings**

   This method is identical to the prior but would estimate an expected credit rating at the time of reinvestment. Maximum-likelihood ratings for each issuer and each year are derived using the original rating, the time of default, and a rating transition matrix. The average default rates for each year would be derived from the expected ratings rather than the original ratings, thus accounting for the rating migration issue noted in the prior method.

   **Pros:** This method improves over the prior two methods by aligning both the ratings and systematic risk factors.

   **Cons:** This method introduces new modeling assumptions, as it requires a transition matrix. It also depends on how maximum likelihood is calculated. This can be convoluted in implementation and lacking in transparency. Comparing this method to the prior, it is unclear whether it is more accurate at a statistically significant level, or if it is distorted by added model assumptions.

From the above five methods, the Academy chose Method 4. Method 1 was not seriously considered because it fails to account for tail risk altogether. Method 2 was briefly considered but ruled out and never tested due to computational limitations. Method 3 was chosen initially to align credit quality. However, after running the six sample deals, it became clear that the systematic error component was the primary driver of tail risk as evidenced by the ACLI/MA Bond Model's sensitivity to the correlation parameter. Accordingly, Method 4 was chosen to align systematic risk factors. Because the reinvestment horizon is in general only 2–3 years, rating migration is a relatively minor problem. Finally, Method 5 was briefly discussed and proposed as a solution to the ratings mismatch, but it was never implemented due to skepticism of false precision and adding more model assumptions.

While collateral losses are simulated across all deals, each CLO's matured balance and recovered balance must be modeled individually per deal. Ideally, the Collateral Model would read in the reinvestment end date for each deal as well as the parameters for reinvestment (e.g., the distribution of credit quality, distribution of seniority for new purchases and average time to maturity). However, due to operational complexity and to reduce model risk, a single set of reinvestment assumptions was used in the Collateral

Model across all deals:

- **Reinvestment horizon:** 2.5 years
- **Credit distribution:** 30% B1, 30% B2 and 40% B3
- **Seniority distribution:** 92.5% senior, 7.5% non-senior
- **Reinvested asset maturity:** Greater than 10 years

This creates a discrepancy between the Collateral Model (single set of reinvestment assumptions across all deals) and the Cash Flow Model (individual CLO deal-specific assumptions are used). If the model is enhanced in future iterations, the code may be adjusted to soft code these assumptions at the deal level along with the CDOnet reinvestment assumptions. That said, the Academy found that the assumptions were reasonable for running the sample deals.

#### *5.1.1.5 Selecting Tail Scenarios*

To achieve the highest precision possible in modeling, all 10,000 simulations of collateral cash flows would be passed through CDOnet. But due to run-time constraints, the Academy was only able to run CDOnet a limited number of times. The Academy chose 17 tail scenarios and a VaR70 scenario to pass through CDOnet (see Appendix C). Each tail scenario represents VaR for a given percentile. The percentiles are increasingly granular towards the right side of the loss tail. The 17 sets of C-1 Factors derived from the CDOnet results are subsequently averaged together using the Midpoint Riemann Sum method to estimate CTE90 (see Appendix C).

The task of choosing the appropriate simulation to represent VaR at a given percentile is not trivial. The goal is to approximate CDOnet's output and reasonably rank-order the simulations.

When processing the original collateral by deal, the time-to-default is pulled for each line item based on its issuer. If the default occurs at the loan's time-to-maturity or before, then a default is assigned as well as the simulated recovery rate. Otherwise, the loan is assumed to have fully matured (even if the issuer does default at a later point in the 10-year window).

In accordance with reinvestment Method 4, the total balance (across all loans) of defaulted issuers is summed, grouped by rating and default year and is divided by the initial balance per rating. This produces default vectors for reinvestment by rating. Grouping by seniority and year, the balance recovered on defaulted issuers is recorded as a proportion of total defaulted balance. This produces recovery vectors for reinvestment by lien.

Before the sixth month of year-3 (i.e., by the end of the 2.5-year reinvestment period), all matured balance and all balance recovered from defaults is summed together and constitutes the reinvested balance. The reinvested balance times the probability of default times the loss-given-default (equal to 1 − recovery rate) is recorded as a loss in a given month. Recovered balance—defined as the reinvested balance times default rate times recovery rate—is added back to the reinvested balance for the next period. At the sixth month of year-3 and thereafter, recovered balance is strictly removed from the reinvestment pool. This procedure generates a vector of losses on reinvestments by month.

The vector of losses from the original collateral and losses from the reinvested amounts are summed together. The total losses are discounted to time 0. A 3.47% (pre-tax) discount rate is used to match the bond model assumption. Losses are assumed to occur mid-month, on average. Thus, a loss that occurs during month-1 is discounted by $(1 + 3.47\%)^{1/24}$. The sum of all discounted losses is recorded as the simulation's present value.

The simulations are rank-ordered by their estimated present value of loss and the 18 target percentiles are selected. For each one, the period of default (year, month) and the recovery rate given default are saved

along with the default and recovery vectors for reinvestment (using Method 4 logic described above).

### 5.1.2 Step 2—CDOnet Cash Flow Projection Model

Cash flow modeling is performed using CDOnet, the structured credit cash flow engine provided by Moody's Analytics (Cash Flow Model). The default rate and recovery rate vectors from the Collateral Model are input into the Cash Flow Model. The Cash Flow Model also inputs parameters for each CLO deal and outputs cash flows by tranche.

CDOnet accepts approximately 100 distinct inputs per run. Of these, 22 are identified as modeler assumptions (as opposed to deal-specific structural parameters extracted directly from deal documents). See Appendix O for the full list of assumptions. The remaining inputs are CLO deal parameters, i.e., fixed facts such as tranche balances, payment dates, coupon rates, attachment/detachment points and contractual structural features. These inputs are populated from deal-level data and are not subject to discretionary modeling choices. The 22 assumption inputs, particularly those designated as material, are the primary focus of this section.

As a general principle, except where explicitly noted, all CDOnet parameters are set in accordance with the NAIC SSG CLO modeling methodology documented on the SSG CLO webpage. This provides an established, publicly available baseline that ensures consistency with regulatory practice and reduces the risk of idiosyncratic or unsupported assumption choices. The Academy's deviations from SSG are intentional and each has a documented rationale grounded in the C-1 RBC framework.

#### *5.1.2.1 Modeling Methodology*

The Academy identified six high-level modeling topics for deliberation, each of which directly shapes one or more CDOnet inputs. These categories serve as the organizing framework for the assumption set:

| Category | Brief Description |
|---|---|
| **Discount Curve** | The reference curve used for valuing cash flows |
| **Credit Spreads** | Market spreads applied to the discount margin |
| **Default Rates** | Default assumptions applied to collateral |
| **Recovery Rates** | Post-default recovery assumptions |
| **Prepayment Rates** | Voluntary prepayment behavior of collateral |
| **Reinvestment** | Assumptions governing reinvestment of principal proceeds during the CLO's reinvestment period |

A seventh topic—whether to capture seasoning of individual CLO deals—was identified as an open question by the Academy. While explicit modeling within CDOnet was not incorporated, seasoning of individual CLO deals was indirectly reflected through the data and parameters used.

The following subsections detail the most discussed of the 22 identified assumptions, with special emphasis on those flagged as material by the Academy. For each, the SSG baseline is noted where applicable, and the Academy's recommendation and rationale are described.

#### *5.1.2.2 Default Vectors and Scenario Selection*

Academy recommendation: Analyze 17 tail scenarios (and one benchmark 70$^{th}$ percentile scenario) selected from the full 10,000-scenario output of the Collateral Model, as described in the previous section. Defaults and recoveries are stochastically simulated and configured to data that can be read by CDOnet.

SSG approach: SSG uses 10 weighted default and recovery scenarios, selected and weighted to minimize the difference between the CLO-level C-1 Factor and the underlying collateral-level C-1 Factor (i.e., enforcing CLO/collateral C-1 equivalence).

Rationale for departure: The Academy's approach does not enforce CLO/collateral C-1 equivalence but

emphasizes modeling consistency where appropriate. The goal of the C-1 CLO factor is to accurately capture the actual credit loss distribution at the CLO tranche level, not to tie it arithmetically to a collateral-level measure. Using 17 scenarios drawn from the full stochastic tail provides a more comprehensive and direct representation of the loss distribution relevant to each tranche. This approach has the further benefit of creating continuity between the ACLI/MA Bond Model and the modeling of CLO collateral.

#### *5.1.2.3 Collateral Prepayment Rate (CPR) and Reinvestment Price*

Academy recommendation: No prepayment (CPR = 0%) and reinvestment at par.

SSG approach: No prepayment and reinvestment at par.

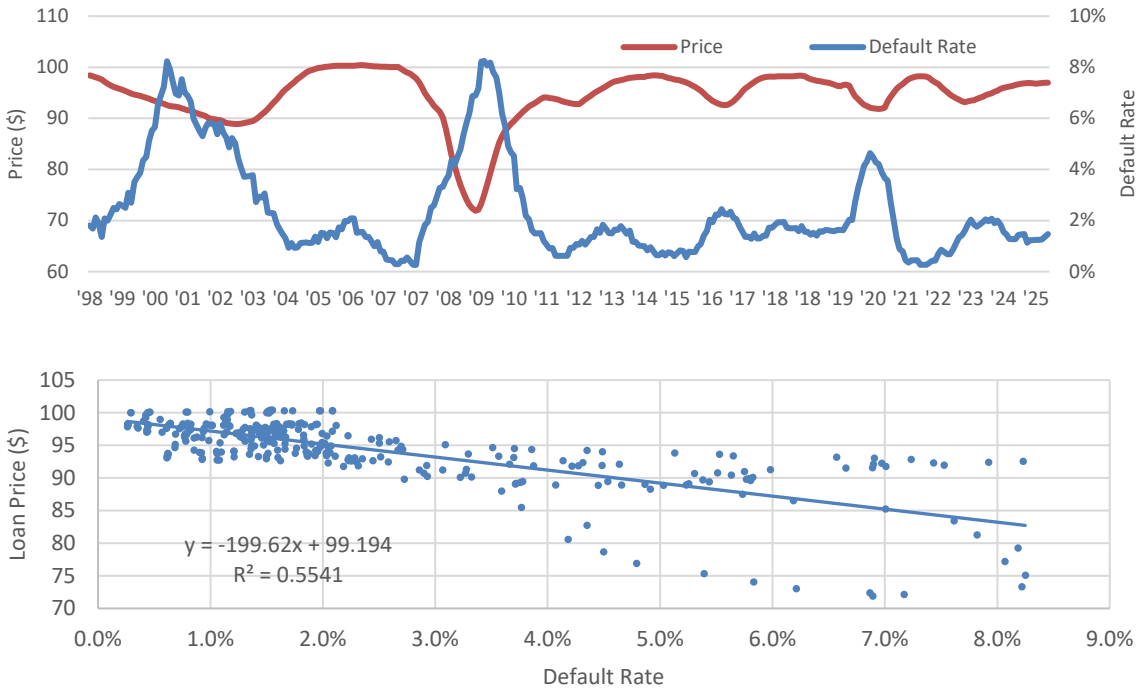
Rationale: This approach is consistent with major rating agency CLO stress methodologies (Moody's, S&P, Fitch), which generally assume no explicit voluntary prepayment under stress. Although eliminating voluntary prepayment does not always result in a more conservative modeled outcome, when combined with reinvestment at par, it increases default exposure and produces more conservative outcomes.

The assumption of reinvestment at par is one of the most frequently discussed assumptions in the C-1 Subcommittee. While reinvesting at par during a stress scenario (where secondary market prices would be distressed) may appear to layer conservatism on top of conservatism, the Academy concluded it is appropriate for consistency with the ACLI/MA Bond Model. In the bond C-1 framework, a five-year bond modeled at the 96th percentile stress scenario is subsequently reinvested and that reinvestment also occurs at par, persisting in the same stress environment. Maintaining the same convention for CLO collateral reinvestment ensures methodological coherence across the C-1 framework. Importantly, the C-1 Subcommittee noted that care must be taken to ensure the 10-year stress horizon is not exceeded as a result of reinvestment mechanics.

A counterargument considered is that the bond model's assumption of reinvestment at par serves to estimate the amount of surplus an insurer will need to replenish reserves. By contrast, CLOs are actively managed and the cost of reinvestment is borne primarily by the equity tranche. While a default directly affects the insurer's surplus in the bond model, a loan default does *not necessarily* result in a default on the CLO debt. Therefore, a divergence from the bond model could plausibly be justified.

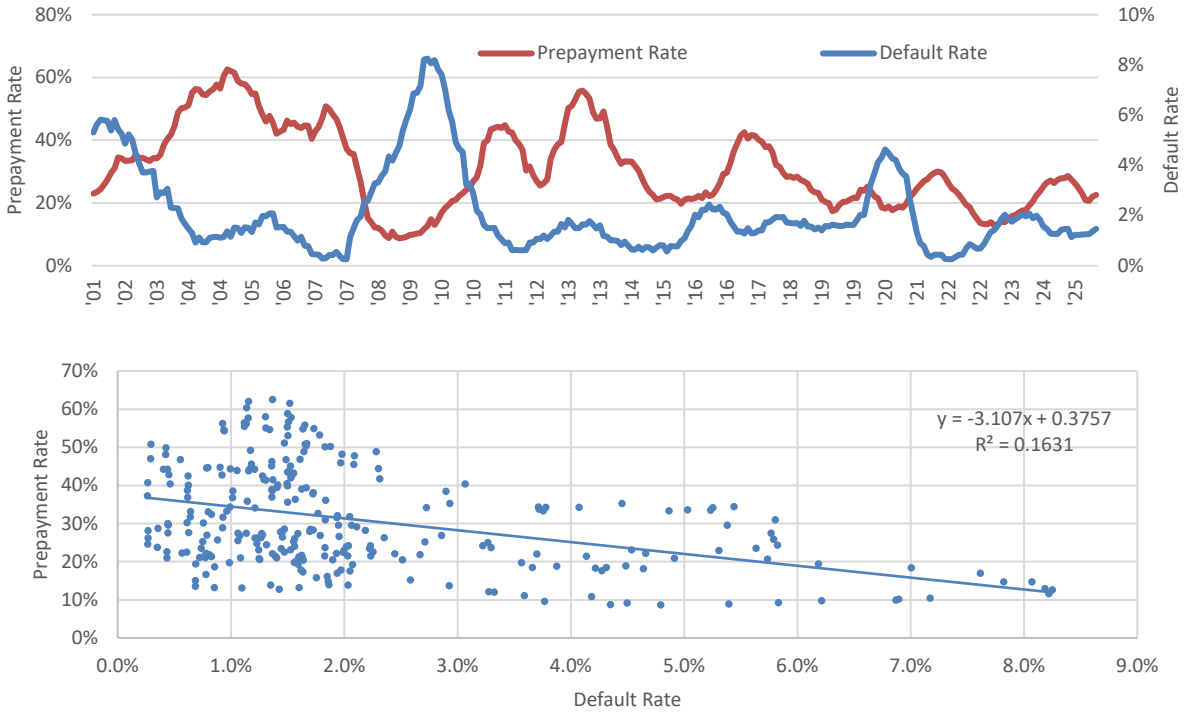
Furthermore, the Academy considers the correlation between default rates, prepayments, and reinvestment prices. When defaults increase, the price of loans is discounted, so reinvesting during a high default period could be done at a discount to par.

**Figure 4 - Leveraged Loan Index Default Rate vs. Price Rolling 12-months**




A similar trend holds with prepayments. When defaults are more common, the rate of prepayment declines.

**Figure 5 - Leveraged Loan Index Default Rate vs. Prepayment Rate Rolling 12-months**



As recorded in Appendix K, Sensitivities 6 and 7, the Academy considered tail risk averages (based on high default rate periods) for the prepayment rate and reinvestment price. The Academy found that the resulting C-1 Factors are highly sensitive to these assumptions.

The assumptions were chosen based on the simplicity of implementation and judgment, erring on the conservative end. With further research, these assumptions could be revised with more sophisticated modeling.

#### *5.1.2.4 Recovery Lag*

Academy recommendation: Immediate recovery; no lag between default event and recovery of proceeds.

SSG approach: 6-month lag between default and recovery.

Rationale: The Academy's choice of immediate recovery is consistent with S&P recovery data conventions, which measure ultimate recovery without applying a time-value penalty for resolution timing. Because the C-1 Factor Model already discounts all cash flows to present value, embedding an additional lag assumption would double-count the time-cost of default resolution. This is a deliberate departure from SSG practice.

#### *5.1.2.5 Structural Trigger Assumptions (OC/IC Tests)*

SSG approach and Academy recommendation: Overcollateralization (OC) and Interest Coverage (IC) tests are modeled per deal documentation, with the standard waterfall mechanics active. These triggers are deal parameters in the strict sense—their thresholds come from deal documents—but the behavioral assumption (i.e., that they function as written and are not waived or modified) is an analytical choice.

Rationale: Allowing OC/IC triggers to redirect cash flows (e.g., de-levering the senior tranches at the expense of junior tranches) is essential to accurately modeling CLO structural protection under stress. Disabling these mechanisms would materially understate tranche-level credit enhancement.

#### *5.1.2.6 Fees and Expenses*

SSG approach and Academy recommendation: Deal-specific fees (management fees, trustee fees, administrative fees) are input per deal documents. Where deal-specific data is unavailable, standard market fee schedules are applied. These are modeled as senior waterfall items and are deducted prior to interest payments to rated tranches.

#### *5.1.2.7 Other Assumptions*

The remaining assumptions include:

- LIBOR/SOFR transition treatment: applicable to legacy deals with LIBOR-referenced collateral; transition handled per Alternative Reference Rates Committee (ARRC) conventions embedded in CDOnet.
- Floor and cap assumptions: modeled per deal documents where interest rate floors/caps exist on collateral or liabilities.
- Optional redemption and refinancing: assumed not to occur during the stress horizon (conservative; consistent with no-prepayment rationale).
- Workout and restructuring assumptions: distressed collateral is modeled as defaulted with the prescribed recovery rate; no partial workout credit is given.
- Collateral diversity and concentration limits: deal-specific; modeled per portfolio data as of the modeling date.

- Currency/FX assumptions: U.S. dollar denominated; FX assumptions not applicable to the primary model run.
- Manager quality: Not explicitly modeled as a qualitative overlay; all CLO managers are treated equivalently within CDOnet.

### 5.1.3 Step 3—C-1 Deal-Level CLO Factor Model

The output files from CDOnet summarize the projected cash flows with the following fields:

- **DEAL_KEY**: Unique system identifier for the CLO deal. Links tranche-level cash flows back to the deal-level collateral pool and structural parameters in CDOnet.
- **TR_KEY**: Unique system identifier for the individual tranche within the deal. Used to join tranche-level cash flows to tranche structural attributes (attachment point, detachment point, rating, etc.).
- **TR_NAME**: Human-readable tranche label as defined in the CLO deal documentation (e.g., "ER2" denotes the second equity/residual tranche). Used for reporting and cross-referencing against the deal term sheet.
- **SCEN**: Scenario index corresponding to one of the 18 percentile scenarios. Scenario 1 corresponds to the 90$^{th}$ percentile, Scenario 17 corresponds to the 99.99th percentile and Scenario 20[19] corresponds to the 70$^{th}$ percentile, for reference.
- **PERIOD**: Sequential monthly period index beginning at 0. Period 0 represents the initial state; subsequent periods represent monthly payment dates through deal maturity or full paydown.
- **PAY_DATE**: Calendar date of the payment period. CDOnet projects cash flows on actual payment dates, following the CLO's contractual payment schedule (typically monthly or quarterly distributions to noteholders).
- **BALANCE**: Outstanding principal balance of the tranche at the end of the period. In this scenario the balance grows during the reinvestment period as new loans are added to the collateral pool, then drops to zero when the tranche is fully written off due to losses.
- **INTEREST**: Cash interest actually paid to the tranche in the period.
- **PRIN**: Cash principal returned to the tranche in the period.
- **LOSSES**: Principal losses allocated to the tranche in the period. Zero in all periods except the final period, where the full outstanding balance plus accumulated deferred amounts are written off, representing complete tranche loss at deal wind-down under this extreme scenario.
- **INT_DUE**: Interest accrued and contractually due to the tranche in the period but not yet paid.
- **INT_DEFERRED**: Cumulative unpaid (deferred) interest balance outstanding as of the period end. Missed CLO tranche payments are recorded as deferrals rather than defaults, consistent with the Academy's C-1 methodology, which distinguishes between tranche payment deferral and outright default.
- **ARREARS**: Principal arrears balance: principal that was contractually due but not paid in the

[19] Scenario numbers were arbitrarily assigned by the Academy for record-keeping purposes.

period.

- **INT_ARREARS**: Interest arrears balance: a sub-component of deferred interest tracking amounts that have aged beyond a specified grace period or that are in formal arrears status per the deal indenture.

- **TR_COUPON**: The tranche coupon rate applicable in the period, expressed as an annualized percentage. The rate is presented as an annualized nominal rate.

#### *5.1.3.1 Debt C-1 Calculations*

A C-1 Factor is intended to represent the maximum present value of loss beyond the risk premium as a proportion of current balance.

Within statutory accounting, an impairment may be taken when there is an expectation of loss. The Academy chooses to assume, for the sake of modeling, that the reporting insurer has perfect foreknowledge. First, this means that the C-1 Factor is always equal to 0 if the final losses are 0; if a payment is missed but ultimately paid, the Academy assumes that no impairment was taken. The code defaults the C-1 to 0 whenever the final loss is 0 to avoid non-zero C-1 from rounding errors. Second, this means that an impairment is taken immediately when the CLO first misses a payment (on either interest or principal) and ends with a non-zero loss.

In the ACLI/MA Bond Model, the risk premium is assigned by rating and is estimated as half a standard deviation above the mean present value of losses. For a standard normal distribution, the 69.15th percentile is one-half of a standard deviation above the mean. Therefore, the Academy considers the $70^{th}$ percentile as a benchmark for risk premium. Unfortunately, the Raw C-1 Factors at the $70^{th}$ percentile are erratic and do not increase alongside decreases in credit quality (see Appendix E). Because of the instability of the $70^{th}$ percentile Raw C-1 Factors and computational constraints, the Academy defers to the existing risk premia numbers used in the ACLI/MA Bond Model.

Also consistent with the ACLI/MA Bond Model, the discount rate is 3.47%, the tax rate is 21% and the tax loss recovery rate is 80%. The adjusted tax rate is then $21\% \times 80\% = 16.8\%$, identical to the ACLI/MA Bond Model. Additionally, the Academy assumes an accumulation rate equal to the discount rate, 3.47%.

With these assumptions, the C-1 Factors are calculated. Appendix D Illustrative CLO Debt Cash Flows to Raw C-1 Factors provides an illustrative example of the calculations. The added fields are as follows:

- **TOTAL_CF:** the sum of INTEREST and PRIN in each period. This represents the total cash received by the investor from the tranche in that period, both the coupon payment and any principal returned.

- **INNER_LOOP_PV:** for each period i, the present value of all future cash flows (TOTAL_CF) from periods i+1 onward, discounted back to period i using the tranche's own coupon rate (TR_COUPON, converted to a monthly rate) as the discount rate. Specifically, for each future period j > i, the cash flow TOTAL_CF[j] is discounted by $(1 + \text{TR_COUPON}[j])^{j-i}$, and all such discounted values are summed. The upper triangular matrix construction enforces that only forward-looking cash flows contribute. This represents the intrinsic economic value of the tranche at each point in time as seen through the lens of its own promised yield. This is the benchmark against which the carrying book value is compared to determine whether an impairment has occurred.

- **PRE_IMPAIRMENT_BV:** the carrying book value of the tranche at the start of each period, before any impairment write-down is applied. In the first period it is initialized to

BALANCE[1] (par value). In each subsequent period r it is rolled forward as: PRE[r] = POST[r−1] × (1 + TR_COUPON[r]) − TOTAL_CF[r]. This is a standard amortized cost carrying value: the prior post-impairment book value accretes at the coupon rate and is reduced by any cash received. It represents what the investor's balance sheet would show before considering whether a further write-down is warranted in the current period.

- **IMPAIRMENT_FLAG:** a binary indicator (0 or 1) that is set to 1 in the first period where two conditions are simultaneously met: (1) the tranche has a non-zero deferred interest balance (INT_DEFERRED > 0) or unpaid principal arrears (ARREARS > 0), signaling that the tranche is not paying in full; and (2) INNER_LOOP_PV is less than PRE_IMPAIRMENT_BV, meaning the present value of remaining cash flows is insufficient to recover the current book value. Once triggered, the flag is permanently latched at 1 for all subsequent periods. This reflects the accounting principle that once an asset is impaired, it remains on an impaired basis even if conditions temporarily improve.

- **IMPAIRMENT:** the write-down amount applied to the book value in each period. It is computed as max(0, PRE_IMPAIRMENT_BV − INNER_LOOP_PV) × IMPAIRMENT_FLAG. When the flag is active, this is the excess of book value over the present value of remaining cash flows, i.e., the amount by which the asset is "underwater." When the flag is zero, the impairment is forced to zero regardless of the present value gap.

- **POST_IMPAIRMENT_BV:** the carrying book value after applying the period's impairment write-down: POST[r] = PRE[r] − IMPAIRMENT[r]. This is the balance sheet value carried forward into the next period's PRE_IMPAIRMENT_BV calculation. Once impairment is recognized and the book value is written down to INNER_LOOP_PV, subsequent accrual occurs from this lower base, preventing double-counting of losses already recognized.

- **RISK_PREMIUM:** a carrying-cost charge applied each period equal to −POST_IMPAIRMENT_BV × (risk premium / 12), where the risk premium is the premium from the ACLI/MA Bond Model for the given rating. It is set to zero in the first period. The risk premium represents the incremental return above the risk-free rate that a rational investor requires to hold an impaired or at-risk tranche.

- **PV_ACCUM_DEFICIENCY:** the pre-tax accumulated present value of all capital deficiency events—impairments and risk premium charges—recognized through each period, measured in present value terms as of period 0. It is computed in three steps: (1) each period's (RISK_PREMIUM + IMPAIRMENT) is scaled by a monthly accumulation factor k = (1 + accumRate / 12) to reflect reinvestment of recognized losses at the accumulation rate; (2) a running cumulative sum of these scaled values is taken and multiplied by k^t to bring the balance to the end of period t; and (3) the accumulated balance is discounted back to period 0 by dividing by (1 + discountRate / 12)^PERIOD. The first period is set to zero by construction. The maximum of this series across all periods forms the numerator of the pre-tax C-1 Factor. That is, it represents the worst-case present value of the capital a life insurer would need to hold to absorb the losses generated in this stress scenario.

- **TAX_BASIS:** the investor's tax basis in the tranche in each period, defined as (BALANCE + ARREARS) when POST_IMPAIRMENT_BV is positive, and zero otherwise. This captures the original cost basis—par plus any accrued but unpaid principal—that the investor is entitled to use for tax loss purposes. It goes to zero when the tranche has been fully written off (POST_IMPAIRMENT_BV = 0), reflecting that there is no remaining basis to deduct once the position is extinguished.

- **UNREALIZED_TAX_LOSS:** the difference between TAX_BASIS and POST_IMPAIRMENT_BV: UNREALIZED_TAX_LOSS = TAX_BASIS − POST_IMPAIRMENT_BV. This measures the gap between what the investor paid (tax basis) and what the tranche is currently worth on the books. The embedded loss has not yet been realized for tax purposes. It drives the deferred tax asset calculation in the following column: an unrealized tax loss creates a future tax benefit that partially offsets the economic loss.

- **REALIZED_TAX_LOSS:** the tax loss realized in each period, multiplied by the adjusted tax rate to convert to a tax cash flow benefit. In the first period it equals −min(TAX_BASIS, LOSSES) × adjTaxRate, capturing the tax benefit from principal losses allocated to the tranche at inception. In subsequent periods it equals (−min(prev_basis, LOSSES) − prev_basis × 1[first impairment period with full write-off]) × adjTaxRate, capturing both ongoing principal losses and the full write-off of the remaining tax basis when the tranche transitions from unimpaired to fully impaired in a single period. The tax benefit from realized losses reduces the effective after-tax cost of credit losses to the insurer.

- **DTA_CHANGE:** the change in the deferred tax asset from one period to the next, computed as (UNREALIZED_TAX_LOSS[r−1] − UNREALIZED_TAX_LOSS[r]) × adjTaxRate, with the first period set to zero. An increase in the unrealized tax loss—meaning the gap between tax basis and book value is growing—creates a positive deferred tax asset (DTA) representing a future tax benefit that reduces the insurer's net capital requirement. A shrinking unrealized loss, for example after a cash interest payment, reverses the deferred tax asset. Including deferred tax asset changes in the accumulated deficiency calculation converts the pre-tax C-1 Factor into a true after-tax measure of capital need.

- **PV_ACCUM_DEFICIENCY_TAX_ADJ:** the after-tax analog of PV_ACCUM_DEFICIENCY. It follows the identical accumulation and discounting structure but uses post-tax rates (postTaxAccumRate, postTaxDiscountRate) and includes REALIZED_TAX_LOSS and DTA_CHANGE alongside RISK_PREMIUM and IMPAIRMENT in the deficiency stream, so that each period's contribution is (RISK_PREMIUM + IMPAIRMENT + REALIZED_TAX_LOSS + DTA_CHANGE).

The maximum of the PV_ACCUM_DEFICIENCY series across all periods, divided by the initial BALANCE, is the pre-tax C-1 Factor (PV_ACCUM_DEFICIENCY_TAX_ADJ produces the post-tax C-1 Factor). The final Raw C-1 Factor is the post-tax factor.

Finally, a weighted average of the 17 tail scenarios is calculated for each CLO debt tranche, estimating each CTE90. The weights are derived from the Midpoint Riemann Sum method (see Appendix C, Scenario Weights).

#### *5.1.3.2 Equity C-1 Calculations*

Under Statutory Accounting Principles (SAP), there are two ways insurers can account for residual tranche equity: allowable earned yield (AEY) and practical expedient. The Academy calculates a separate set of C-1 Factors for each of the two accounting methodologies.

AEY requires the insurer to estimate the book yield of the residual tranche as the internal rate of return (IRR) that equates best-estimate projected cash flows with the purchase price. The book yield times outstanding book value constitutes the "allowable" income. Any income above the "allowable" income reduces or pays down book value. Any time the residual tranche fails to pay out the book yield, a shortfall is recorded and it can be made up by future payments. Once the book value is reduced to $0, all payments are recorded as income.

If a residual tranche, whose book value is $100 and book yield is 20%, receives $30 in a year, the first $20 is income and the remaining $10 ($30 − $20) is paid down book value. This means the book value is reduced from $100 to $90. In the next year, the allowable yield is $18, i.e., 20% of $90, which means that an additional $30 is recorded as $18 of income and $12 of book value. By contrast, if the residual tranche pays only $10 in the first year, a $10 shortfall is recorded and $30 is owed the next year (due to the additional $20 of allowed income in the second year). If the residual tranche pays $30 in the next year, the shortfall is brought back down to 0. If it exceeds $30, then the amount in excess of $30 is paid down as book value.

Practical expedient accounting is a special case of AEY where the book yield is set equal to 0%. This means that no income is recorded until the book value is fully reduced to $0.

In Table 4, a simple illustration is presented where the residual tranche has a balance of $100. Note that when there is an outstanding shortfall, the amount recorded as income can exceed that year's AEY (until the shortfall is closed). Under practical expedient there is no concept of shortfall, and income is only recorded after the book value is brought down to $0.

The total income earned under AEY sums to $89 while the income sums to only $49 under practical expedient. This is not an accounting error; it is explained by the outstanding $40 of book value under AEY. Any outstanding book value is realized as a loss when the position closes. In this example, the realized IRR is 13%, well below the 20% book yield, which is why a loss is recorded.

**Table 4 - Residual Tranche Accounting Illustration**

| | | | *Allowable Earned Yield (20% IRR)* | | | | *Practical Expedient* | | |
|---|---|---|---|---|---|---|---|---|---|
| *Period* | *Balance* | *Interest* | *Book Value* | *Allowed Yield* | *Income* | *Shortfall* | *Book Value* | *Income* | *Shortfall* |
| *0* | $100 | | $100 | | | | $100 | | |
| *1* | $100 | $30 | $90 | $20 | $20 | $0 | $70 | $0 | $0 |
| *2* | $100 | $10 | $90 | $18 | $10 | $8 | $60 | $0 | $0 |
| *3* | $100 | $20 | $90 | $18 | $20 | $6 | $40 | $0 | $0 |
| *4* | $100 | $39 | $75 | $18 | $24 | $0 | $1 | $0 | $0 |
| *5* | $100 | $50 | $40 | $15 | $15 | $0 | $0 | $49 | $0 |

Any change to a residual tranche's book value will result in a 1-to-1 change to its owner's Total Adjusted Capital (TAC), which is the numerator of the RBC ratio. Because practical expedient's book value falls faster than AEY's, it contributes less to TAC. It also requires a more severe loss event to cause a loss on book value. Additionally, because the Academy assumes equity does not back liabilities, statutory income generated by residual tranches is assumed to increase surplus 1-to-1. Such income can offset later losses, since C-1 estimates only *net* surplus required to cover losses.

When estimating the book yields for AEY, the Academy pulls the historical balance, principal (i.e., contributions to balance[20]) and interest paid by the residual tranche. The Academy also runs a baseline simulation through CDOnet to produce future projected cash flows. In this baseline run, the default rates by year and rating and the recovery rates by lien are set equal to the Collateral Model parameters (i.e., the average). The resulting projected cash flows are concatenated with the historical cash flows and a simple cash flow IRR is calculated.

[20] When a CLO reset occurs, the Academy assumes that the observed increase in principal balance results from a corresponding capital contribution of the same amount. However, this is not necessarily the case and may result in imprecise estimates of starting book values.

Appendix F shows 42.55% of residual tranches have an IRR ≤ 0%. Among the securities that have non-zero IRRs, the average IRR is only 9.43% with a median of 7.06%. The total average IRR is 5.42% and the total median is 2.29%. This is well below typical IRR projections for residual tranches, and it suggests that the Collateral Model parameters (default rates and recovery rates) may be unrealistically conservative.[21]

The model's conservatism is exacerbated by the fact that the IRRs should be skewed up by survivorship bias. The Academy has already filtered the universe to securities that are outstanding on 12/31/24; residual tranches of CLOs that defaulted before 12/31/24 are already excluded. Rather than going back to the start date of each CLO and running the projections from then, the Academy assumes that the insurer precisely estimated the cash flows that occurred before 12/31/24. This carries the implicit assumption that the insurer correctly predicted the survivorship, which will skew up any IRR calculation. This bias is borne out in the data. Among CLOs with no historical cash flows (before 12/31/24), the mean IRR is only 2.50% and median is 0.00% (well below the mean and median IRRs for seasoned residual tranches).

Nevertheless, to retain internal consistency, the Academy uses the baseline IRRs as the book yield when estimating book values under allowable earned yield.

For each security and each of the simulations from CDOnet, the Academy concatenates the projected cash flows with the historical cash flows. The Academy assumes that the insurer bought the residual tranche at issue and set the initial book value equal to the initial balance. For the full time series (history and projected), the calculated fields are as follows:

- **TOTAL_CF:** the sum of INTEREST and PRIN in each period. This represents the total cash received by the investor from the tranche in that period. PRIN is 0 in the future projections but can be negative in the historical cash flows when additional principal was contributed to the tranche by the investor.

- **MAX_AEY:** Prior book value (balance at the start) times the book yield (allowable earned yield). This is the maximum amount of additional income that can be recorded.

- **SHORT_FALL:** Calculated as min(INTEREST − MAX_AEY + prior SHORT_FALL, 0), this represents the cumulative allowable income missed. If the interest is large enough to cover new allowable earned yield and the prior shortfall, the shortfall is brought to 0. When a shortfall exists, the field SHORT_FALL is negative.

- **PAID_BV:** Calculated as min(prior BV, max(INTEREST − MAX_AEY + prior SHORT_FALL, 0)), this represents the leftover interest that goes towards paying down book value. If the interest exceeds AEY and shortfall, the interest pays down book value (and cannot exceed prior STAT_BV, since BV does not go below 0).

- **PAID_OFF_BV_INCOME:** Calculated as max(INTEREST − MAX_AEY + prior SHORT_FALL − PAID_BV, 0), this represents the amount of interest that gets calculated as income after STAT_BV goes to 0. Once STAT_BV is 0, all interest is income.

- **STAT_INCOME_PRE_TAX:** This is the total statutory income. It is calculated as min(INTEREST, MAX_AEY) + max(SHORT_FALL − prior SHORT_FALL) + PAID_OFF_BV_INCOME. If the interest is below the MAX_AEY, then all interest is statutory

[21] Because the residual tranche has a higher risk of loss than any of the debt tranches, investors would only buy the residual tranche if they expect it to generate a higher return than what they expect on the debt tranches. Yet these IRRs of 5.42% or 2.29% are well below the yields paid by debt tranches. When a model disagrees with market pricing, a prudent modeler defers to the market and looks for potential flaws in the model.

income. If it exceeds the AEY, the AEY goes to income as well as any recuperated shortfall. If the book value falls to 0, the statutory income is realized through PAID_OFF_BV_INCOME.

- **TAX:** −21% × INTEREST. All interest is taxed at the standard rate. The sign is flipped to negative because it constitutes a reduction in statutory income.

- **STAT_INCOME_POST_TAX:** STAT_INCOME_PRE_TAX + TAX.

- **STAT_BV:** Calculated as max(prior STAT_BV − PAID_BV − PRIN, 0), the book value is reduced by interest in excess of the AEY (and recuperated shortfall) and is adjusted by principal payments (the principal payments are only applicable to historical cash flows).

- **REALIZED_LOSS_BV:** Equal to −STAT_BV in the final period and 0 everywhere else, this is the remaining book value that is recorded as an accounting loss.

- **REALIZED_LOSS_BALANCE:** Equal to −BALANCE in the final period and 0 everywhere else, this is the remaining balance that is recorded as a loss for tax purposes.

- **DTA:** Equal to 0 in the last period, the DTA is everywhere else 21% × (BALANCE − STAT_BV). When the balance exceeds the statutory book value, there will be a tax loss in the last period that is not an accounting loss. The tax benefit from that loss can be treated as an asset.

- **DELTA_DTA:** DTA − prior DTA.

- **DEFICIENCY:** This represents the change to current surplus. For all periods before 12/31/24, the DEFICIENCY is set to 0 since past events have no impact on current surplus. For projected dates, DEFICIENCY = 1.0347 × prior DEFICIENCY + STAT_INCOME_POST_TAX + REALIZED_LOSS_BV − 21% × REALIZED_LOSS_BALANCE + DELTA_DTA. Because C-1 assumes a discount factor of 3.47%, the deficiency is assumed to accumulate at a rate of 3.47% so that the present value is not artificially contracted by the delay of losses (the accumulation and discounting offset one another). When taxes exceed the statutory income, the statutory income is negative and contributes to deficiency. When a loss is realized at the end, REALIZED_LOSS_BV is negative and contributes to the deficiency but is offset by the tax benefit on the lost balance.

- **DEFICIENCY_PV:** The present value of deficiency, DEFICIENCY / $1.0347^t$, where t is the time (in years) since 12/31/24.

The maximum deficiency is −1 × min(DEFICIENCY_PV) since deficiency is a negative value when a loss occurs. The ratio of the maximum deficiency to the 12/31/24 book value constitutes the C-1 Factor. Like the bond factors, the aggregated C-1 Factor estimates CTE90 and is based on the 17 tail scenarios and derived from the Riemann sum.

While equity does not typically back liabilities, the Academy added the option to assume that the security is liability-backing. All of the calculations run identically, except the DEFICIENCY field only adds STAT_INCOME_POST_TAX if it is negative. The model assumes that if statutory income is positive, the excess cash flow goes towards paying off a liability rather than offsetting deficiency in surplus.

As mentioned, the practical expedient accounting follows the exact same logic with book yield forced to 0%.

## 5.2 Modeled Debt C-1 Factors by Comparable Attributes

The Academy seeks to identify comparable attributes across CLO debt tranches that can be used to prescribe C-1 Factors. In the ACLI/MA Bond Model, agency ratings serve as the fundamental comparable attribute.

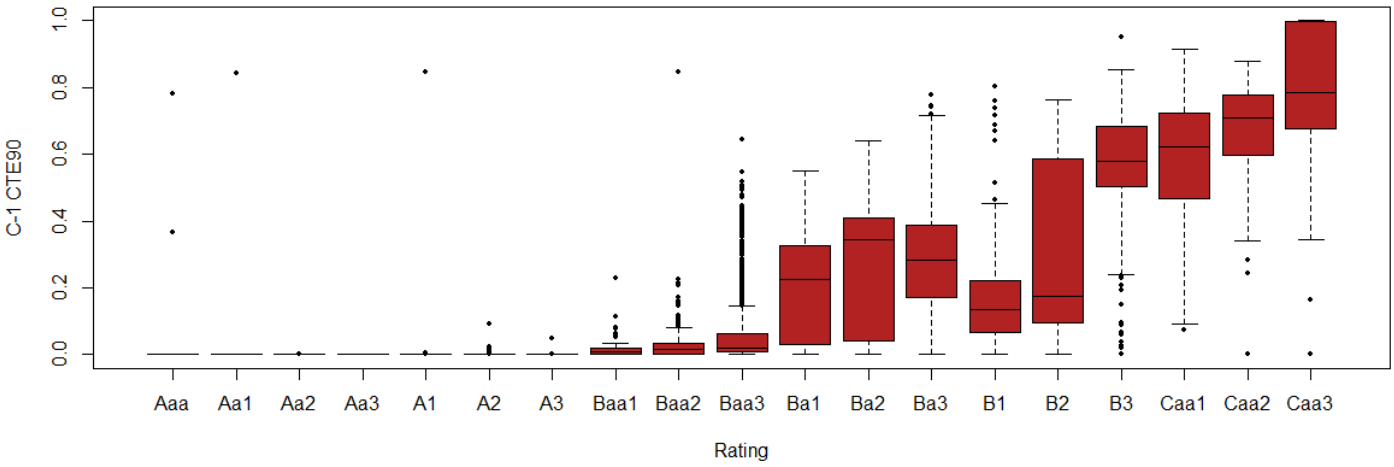
The Academy uses OLS regression models to test various combinations of comparable attributes and to produce Modeled C-1 Factors.

As detailed in Appendix G, the Academy observes that a ratings-only model has better explanatory power than a regression against all other comparable attributes combined, absent data transformations. Accordingly, the Academy first develops the ratings-only model and seeks to identify attributes that contain explanatory power orthogonal to agency ratings.

### 5.2.1 Ratings-Only Base Model

When the Academy groups Raw C-1 Factors by rating, several observations are immediately apparent that suggest ratings do not sufficiently explain the variance of factors.

**Figure 6 - CLO Debt Raw C-1 Factors by Tranche Rating**




As illustrated in the Figure 6 box plot:

(1) **Aa3:** has no non-zero observations
(2) **A3:** has fewer extreme outlier points than the adjacent ratings
(3) **Baa3:** has the highest proportion of outlier points
(4) **Ba3/B1/B2:** do not increase monotonically

Some of the observed anomalies are explained by credibility issues. As will be explained later, this is the Academy's conclusion with respect to A/above ratings. The other explanation is hidden covariates not captured by rating.

### 5.2.2 Identifying Most Explanatory Covariate

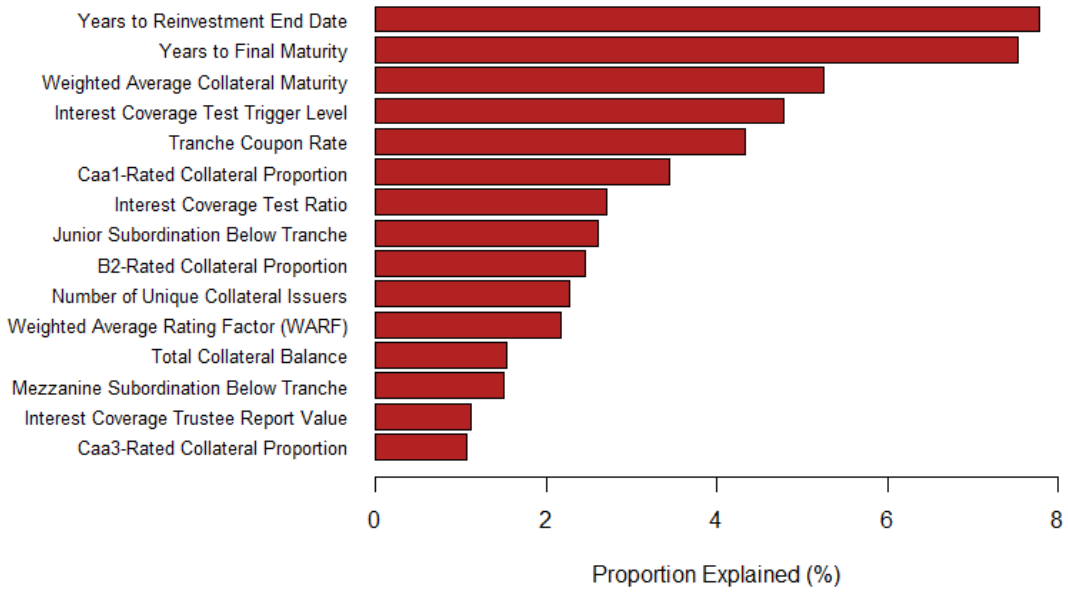
To test the presence of such potential covariates, the Academy takes the ratings-only model as the reference point and adds in each covariate individually to identify the additional proportion of variance explained. The Academy elects to use an OLS regression for this process. Simple "average" is by definition a least-squares solution ("median" is a least-magnitude solution); therefore, regressing the Raw C-1 Factors against dummy variables (i.e., indicators that equal 1 if true and 0 if false) for each rating is identical to

running a simple average by rating. The OLS framework allows the Academy to add additional factors into the model and monitor the variance of residual error to evaluate relative goodness of fit.

When running these iterative regressions, and filtering down to the top 15 most explanatory covariates (without transformation), a clear story emerges: the predominant source of explained variance not captured by ratings is time to maturity. The top three covariates are the years until reinvestment end date, until final maturity and until average collateral maturity. All three are highly correlated; therefore, it is sufficient to choose one.

The Academy chooses **reinvestment end date** given that: 1) it is the most explanatory covariate; 2) it is easier to compute than collateral maturity; and 3) it is more objective than final maturity. Final maturity is chosen for legal contractual purposes and does not represent the time principal is actually repaid due to prepayments. By contrast, the reinvestment end date drives the timing in principal repayment and is integral to the CLO's structure.

**Figure 7 - Proportion of Added Explained Variance, Top 15 Predictors (Over Rating)**




### *5.2.2.1 Deriving "Horizon-Neutral" Factors*

In the ACLI/MA Bond Model, time to maturity is mechanically ignored. All bonds are treated as having maturities greater than 10 years; when a default occurs, it is assumed that an identical bond with maturity greater than 10 years replaces it. Defaults are modeled based on generic issuers by rating. Because the CLO model relies on real-world securities rather than hypothetical instruments, the Academy's results have the impact of maturity embedded within them.

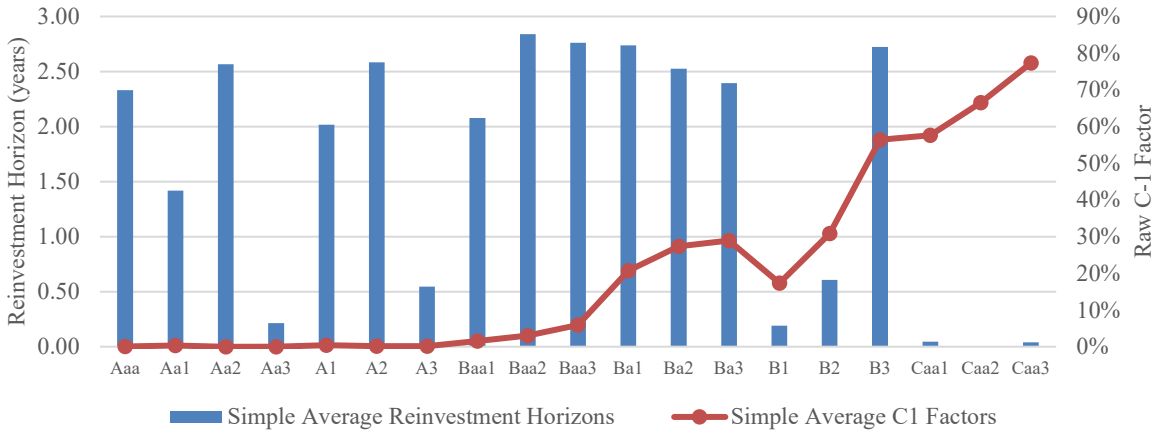
To maintain continuity with the logic of the ACLI/MA Bond Model, the Academy determines that CLO factors should be **horizon-neutral.** That is to say, if two CLO debt tranches are otherwise identical but one has a shorter time to reinvestment end date, they should receive the same C-1 Factor despite the shorter CLO having less risk (due to its shorter horizon).

This can be cleanly accomplished within the OLS framework by regressing Raw C-1 Factors against both rating and the "reinvestment horizon" (years until reinvestment end date) and then fixing the reinvestment horizon to a universe average. For example, an A3 bond's Modeled C-1 Factor would equal the A3 dummy coefficient + reinvestment horizon coefficient × average reinvestment horizon.

This approach would be inappropriate should there exist correlation between agency rating and reinvestment horizon. For example, assume hypothetically that bonds were automatically upgraded when the reinvestment end date was reached. Then higher-rated bonds would have mechanically shorter reinvestment horizons. It would be inappropriate to assign the average horizon to the AAA bonds because the AAA bonds would necessarily have a below-average reinvestment horizon.

The Academy used a Pearson's Product-Moment Correlation Coefficient Test to evaluate this concern. This test found a correlation between reinvestment horizon and numeric agency rating (Aaa = 1, …, Caa3 = 19) of -1.2% with a p-value of 19.1%. This weak correlation and failure to identify statistical significance indicate that reinvestment horizon does not meaningfully trend with rating. Therefore, the Academy elects to use a simple average reinvestment horizon across all ratings, 2.395 years.

**Figure 8 - Reinvestment Horizon and Raw C-1 Factors by Rating**




When the Academy plots the average Raw C-1 Factors against rating as well as the reinvestment horizons, it becomes plausible that the lack of monotonicity in the Ba3–B3 range is attributable to disproportionately short reinvestment horizons. Unfortunately, a simple regression against ratings and reinvestment horizon does not automatically solve this.

#### *5.2.2.2 Interaction Between Ratings and Horizon*

In the below table, the "Baseline" factors are the simple averages by rating. The "No Interaction" column adds in reinvestment horizon as a covariate without any interaction terms. The result is erratic implied factors, e.g., −0.22% for Aa2 and 2.57% for A3. This suggests that the relationship between C-1 and reinvestment horizon is not strictly linear; since the lower-credit-quality bonds have greater variation in C-1, they have greater sensitivity to horizon. If one coefficient is used across all ratings, A/above rated securities are treated as if they have the same variance as high-yield bonds.

**Table 5 - Modeled C-1 Factors (%) Regressed against Ratings, Reinvestment Horizon and Interactions**

| | Baseline | No Interaction | IG/HY | Rating Letters | Proposed Buckets | Alternative Buckets | Ratings Granular |
|---|---|---|---|---|---|---|---|
| Aaa | 0.03 | 0.12 | 0.07 | 0.03 | 0.03 | 0.03 | 0.03 |
| Aa1 | 0.28 | 1.58 | 0.80 | 0.27 | 0.27 | 0.27 | 0.18 |
| Aa2 | 0.00 | -0.22 | -0.09 | 0.00 | 0.00 | 0.00 | 0.00 |
| Aa3 | 0.00 | 2.88 | 1.15 | -0.04 | 0.04 | 0.04 | 0.00 |
| A1 | 0.40 | 0.90 | 0.60 | 0.41 | 0.41 | 0.41 | 0.35 |
| A2 | 0.11 | -0.14 | 0.01 | 0.10 | 0.10 | 0.10 | 0.10 |
| A3 | 0.12 | 2.57 | 1.10 | 0.16 | 1.45 | 0.16 | 0.05 |
| Baa1 | 1.58 | 2.00 | 1.75 | 2.25 | 1.81 | 1.81 | 1.80 |
| Baa2 | 3.02 | 2.44 | 2.79 | 2.08 | 2.70 | 2.70 | 2.69 |
| Baa3 | 5.94 | 5.46 | 5.75 | 5.17 | 4.83 | 4.83 | 5.01 |
| Ba1 | 20.70 | 20.25 | 18.95 | 18.60 | 19.66 | 19.66 | 18.43 |
| Ba2 | 27.37 | 27.20 | 26.71 | 26.58 | 26.98 | 26.98 | 26.27 |
| Ba3 | 28.92 | 28.92 | 28.92 | 28.92 | 28.92 | 28.92 | 28.92 |
| B1 | 17.34 | 20.25 | 28.61 | 18.98 | 30.84 | 30.84 | 40.14 |
| B2 | 30.81 | 33.17 | 39.95 | 32.13 | 41.76 | 41.76 | 63.83 |
| B3 | 56.39 | 55.96 | 54.72 | 56.15 | 56.68 | 56.68 | 56.61 |
| Caa1 | 57.60 | 60.70 | 69.61 | 5.00 | 55.57 | 55.57 | 32.87 |
| Caa2 | 66.51 | 69.67 | 78.76 | 12.89 | 64.45 | 64.45 | -15.45 |
| Caa3 | 77.33 | 80.44 | 89.37 | 24.59 | 75.30 | 75.30 | -3.27 |
| Adjusted $R^2$ | 74.69 | 80.35 | 83.22 | 84.77 | 84.82 | 84.82 | 85.47 |

As an illustration, the "IG/HY" column adds an interaction term for IG assets. This means the factors by rating are derived from the rating coefficient plus the reinvestment horizon coefficient, adjusted for the dummy times average time to reinvestment. Using Baa3 and Ba1 as examples (numbers from Table 6):

- **Baa3:** $0.0449 + (0.0511 - 0.0459) \times 2.395 =$ **5.75%**
- **Ba1:** $0.0670 + (0.0511) \times 2.395 =$ **18.95%**

The −0.0459 component is the IG interaction term, which adjusts the coefficient on reinvestment horizon down to reflect the lower sensitivity in the IG range.

**Table 6 - Modeled C-1 Factor vs. Rating, Reinvestment Horizon and IG Flag × Reinvestment Horizon**

| Parameter | Estimate | Std. Error | t-value | p-value |
|---|---|---|---|---|
| Aaa | −0.0119 | 0.0016 | −7.66 | 1.95e−14 |
| Aa1 | −0.0046 | 0.0044 | −1.05 | 0.2942 |
| Aa2 | −0.0135 | 0.0020 | −6.66 | 2.85e−11 |
| Aa3 | −0.0011 | 0.0091 | −0.12 | 0.9015 |
| A1 | −0.0066 | 0.0049 | −1.35 | 0.1755 |
| A2 | −0.0125 | 0.0021 | −5.87 | 4.59e−09 |
| A3 | −0.0016 | 0.0117 | −0.14 | 0.8895 |
| Baa1 | 0.0049 | 0.0059 | 0.83 | 0.4055 |
| Baa2 | 0.0153 | 0.0041 | 3.68 | 0.0002 |
| Baa3 | 0.0449 | 0.0020 | 22.11 | < 2e−16 |
| Ba1 | 0.0670 | 0.0073 | 9.14 | < 2e−16 |
| Ba2 | 0.1446 | 0.0088 | 16.53 | < 2e−16 |
| Ba3 | 0.1667 | 0.0028 | 58.99 | < 2e−16 |
| B1 | 0.1636 | 0.0061 | 27.00 | < 2e−16 |
| B2 | 0.2770 | 0.0148 | 18.78 | < 2e−16 |
| B3 | 0.4247 | 0.0048 | 88.59 | < 2e−16 |
| Caa1 | 0.5736 | 0.0106 | 53.96 | < 2e−16 |
| Caa2 | 0.6651 | 0.0105 | 63.19 | < 2e−16 |
| Caa3 | 0.7713 | 0.0099 | 78.14 | < 2e−16 |
| REINV_END_DATE | 0.0511 | 0.0009 | 57.48 | < 2e−16 |
| REINV_END_DATE_IG | −0.0459 | 0.0010 | −46.89 | < 2e−16 |

Unfortunately, the IG interaction term does not preclude the model from producing abnormal results, including negative charges for certain A/above ratings. One might consider, as a potential solution, including interaction terms with each rating. This would, in effect, regress Raw C-1 Factors against reinvestment horizon independently for each rating. The results are shown in the final column, "Ratings Granular." Unsurprisingly, the Modeled C-1 Factors for B1 and below become erratic with the Caa2 charge flipping negative. The adjusted $R^2$ is the highest among the considered models, but it is evidently the product of overfitting and the model should be discarded.

The three middle columns in Table 5 seek to reconcile the approaches by presenting three alternate groupings:

| | Rating Letters | Proposed Buckets | Alternative Buckets |
|---|---|---|---|
| Bucket 1 | AAA | AAA | AAA |
| Bucket 2 | Aa1 / Aa2 / Aa3 | Aa1 / Aa2 | Aa1 / Aa2 |
| Bucket 3 | A1 / A2 / A3 | Aa3 / A1 / A2 | Aa3 / A1 / A2 / A3 |
| Bucket 4 | Baa1 / Baa2 / Baa3 | A3 / Baa1 / Baa2 | Baa1 / Baa2 |
| Bucket 5 | Ba1 / Ba2 / Ba3 | Baa3 / Ba1 / Ba2 | Baa3 / Ba1 / Ba2 |
| Bucket 6 | B1 / B2 / B3 | Ba3 / B1 / B2 | Ba3 / B1 / B2 |

The first grouping groups together ratings by their letter. This accounts for the fact that a typical CLO only has one tranche per letter (e.g., Aaa, Aa2, A2, Baa3) and so it adds credibility. However, it still produces unintuitive results like the negative C-1 at Aa3 and it fails to fix the monotonicity break at Ba3–B3.

The next column, "Proposed Buckets," is the method proposed by the Academy. One concern with the "Rating Letters" method is that it implicitly groups Caa1/Caa2/Caa3 together; these ratings cumulatively account for less than 0.25% of total CLO debt balance. Adding B3 (implicitly) to this group doubles the group's balance, thus increasing its credibility. However, by removing B3 from Bucket 6, Bucket 6 suffers

credibility concerns. Both B1 and B2 are comparatively small tranches and they are the tranches observed to have compressed horizons. Ba3 is added to Bucket 6. By the same logic, Baa3 is added to Bucket 5 since Ba1 and Ba2 are thin.

This approach successfully fixes the monotonicity across the high-yield ratings. The Modeled C-1 Factors strictly increase from Baa1 to Caa3. Where the approach runs into trouble is in A3. A3 is another tranche that has a compressed reinvestment horizon. Most CLOs are structured with an A2 tranche and Baa3 tranche. This means that there is limited data for A3, Baa1, and Baa2. If Baa3 is moved to Bucket 5, then Bucket 4 will lack a traditionally issued tranche (Aaa goes in Bucket 1, Aa2 goes in Bucket 2 and A2 goes in Bucket 3). A3 could be plausibly grouped in either Bucket 3 (so that it is paired with A2 for better credibility) or in Bucket 4 so that Bucket 4 has more observations. The "Alternative Buckets" column presents this alternative grouping.

The difference between "Proposed Buckets" and "Alternative Buckets" does not yield a decisive narrative. They both meaningfully improve the adjusted $R^2$ over the baseline and fix the monotonicity in the high-yield ratings. In fact, all factors except the A3 factor are identical in the two models and the adjusted $R^2$ values are identical. Despite the models being otherwise similar, the A3 charge falls by more than a factor of 9, going from 1.45 to 0.16. The Academy initially proceeded with "Proposed Buckets." This concern is further addressed in Section 5.2.6.

### 5.2.3 Comparable Attributes Beyond Ratings and Horizon

After adding reinvestment horizon to the OLS as described, the Academy investigated whether other comparable attributes have explanatory power for the remaining variance in C-1. When repeating the exercise of adding factors one by one to the OLS regression (which already includes rating, reinvestment horizon and the interaction terms), the Academy observes:

(1) All other factors individually explain less than 4% of remaining variance
(2) Only coupon rate explains more than 2% of remaining variance
(3) Final maturity and weighted average collateral maturity become less significant
(4) Attachment and detachment points show up with modest explanatory power

**Figure 9 - Proportion of Added Explained Variance, Top 15 Predictors (Over Rating and Reinvestment Horizon)**

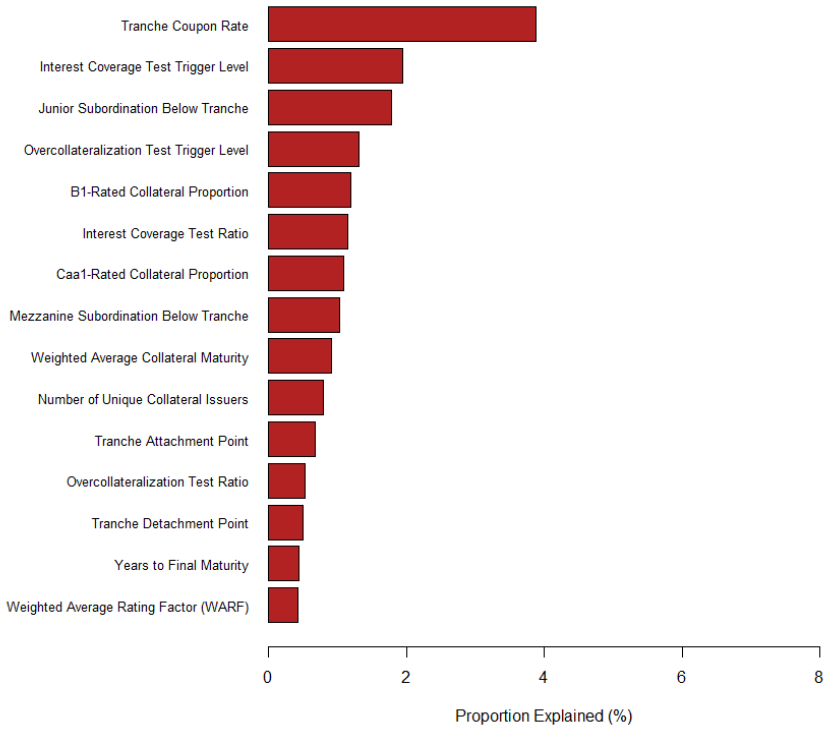



**Table 7 - C-1 vs. Rating, Reinvestment Horizon (with Interactions) and Tranche Coupon Rate**

| | Estimate | Std. Error | t value | Pr(>\|t\|) |
|---|---|---|---|---|
| Aaa | -0.0919 | 0.0045 | -20.62 | 0.000 |
| Aa1 | -0.0960 | 0.0061 | -15.79 | 0.000 |
| Aa2 | -0.0960 | 0.0050 | -19.03 | 0.000 |
| Aa3 | -0.1068 | 0.0097 | -11.00 | 0.000 |
| A1 | -0.1046 | 0.0068 | -15.42 | 0.000 |
| A2 | -0.1081 | 0.0056 | -19.29 | 0.000 |
| A3 | -0.1174 | 0.0121 | -9.72 | 0.000 |
| Baa1 | -0.1285 | 0.0085 | -15.19 | 0.000 |
| Baa2 | -0.1206 | 0.0081 | -14.92 | 0.000 |
| Baa3 | -0.1516 | 0.0062 | -24.33 | 0.000 |
| Ba1 | -0.0363 | 0.0098 | -3.70 | 0.000 |
| Ba2 | 0.0243 | 0.0111 | 2.19 | 0.029 |
| Ba3 | -0.0363 | 0.0084 | -4.34 | 0.000 |
| B1 | -0.0154 | 0.0096 | -1.60 | 0.109 |
| B2 | 0.0874 | 0.0159 | 5.48 | 0.000 |
| B3 | 0.3820 | 0.0113 | 33.84 | 0.000 |
| Caa1 | 0.3771 | 0.0132 | 28.53 | 0.000 |
| Caa2 | 0.4635 | 0.0132 | 35.07 | 0.000 |
| Caa3 | 0.5873 | 0.0123 | 47.70 | 0.000 |
| REINV_END_DATE | -0.0071 | 0.0021 | -3.48 | 0.001 |
| REINV_END_DATE_1 | 0.0060 | 0.0021 | 2.81 | 0.005 |
| REINV_END_DATE_2 | 0.0057 | 0.0022 | 2.56 | 0.011 |
| REINV_END_DATE_3 | 0.0069 | 0.0022 | 3.08 | 0.002 |
| REINV_END_DATE_4 | 0.0149 | 0.0026 | 5.81 | 0.000 |
| REINV_END_DATE_5 | 0.0354 | 0.0022 | 15.99 | 0.000 |
| REINV_END_DATE_6 | 0.0677 | 0.0023 | 29.83 | 0.000 |
| TR_COUPON | 0.0158 | 0.0007 | 22.78 | 0.000 |

In Appendix G, a litany of regressions run by the Academy are presented with commentary on their comparative advantages.

Since tranche coupon rate is the only attribute with noticeably more explanatory power than the other variables, it is tested as a factor in the OLS. The result is that $R^2$ increases by 0.71% and the coefficient on the coupon rate is positive (with statistical significance); this is intuitive since it implies that when a CLO has a greater interest obligation, it has a greater risk of loss.

That said, this logic also applies to bonds where coupon rate is not considered as a comparable attribute. Because adding coupon rate does not improve the shape of the fit nor substantially improve $R^2$ and because it is a clear departure from the bond C-1 framework, the Academy does not affirmatively recommend coupon rate as a comparable attribute.

As noted above, attachment and detachment points (AP and DP) enter the top 15 attributes after adjusting for reinvestment horizon. They only explain ~0.5% of remaining variance, which may suggest that they are not informative. However, a substantial limitation of the single-variable stress test analysis is that it assumes no variable transformation.

At an intuitive level, AP and DP should be able to ballpark the risk profile of a CLO debt tranche by themselves. This is because credit quality of a CLO is secured by its risk-protection structure. AP and DP indicate how much protection each bond has. The reason these do not show up as the most explanatory covariates (over rating) is that they are already implicit in rating. A typical CLO has an Aaa/Aa2/A2/Baa3 structure where each rating corresponds to a general (AP, DP) range.

In Appendix G, it can be seen that if AP and DP are subdivided enough times, they can individually produce $R^2$ values comparable with that produced by the ratings-only model. For example, if detachment point is subdivided 50 times, then there would be an average factor for bonds with $DP \in [0\%, 2\%)$ and a different charge for $DP \in [2\%, 4\%)$ and so forth. When DP is subdivided 50 times and these subdivisions are added to the Ratings + Reinvestment Horizon (with interactions) model, they increase the adjusted $R^2$ from 81.63% to 85.63%. This hints that DP may contain non-linear explanatory power.

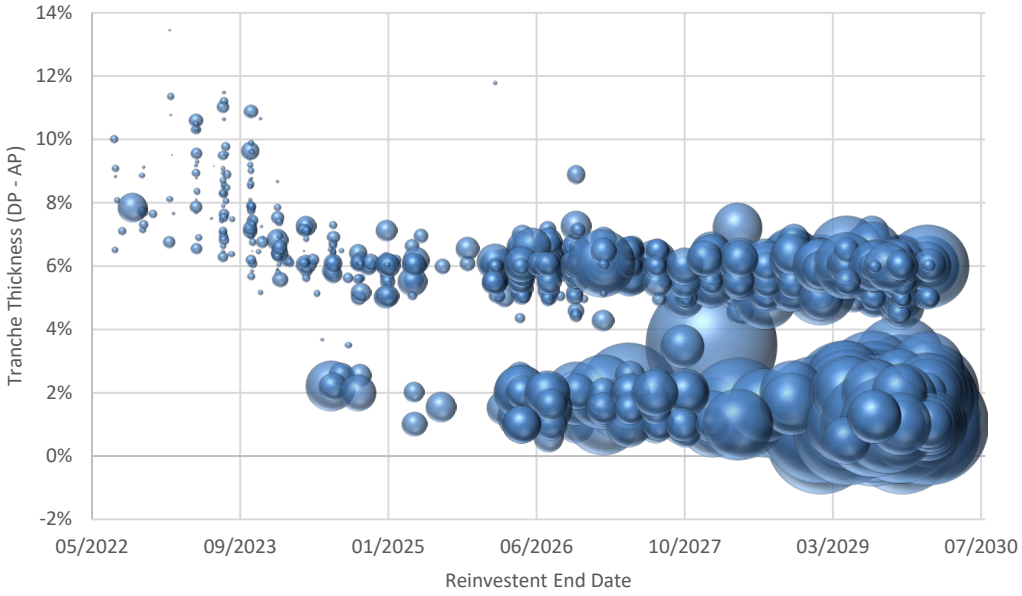
#### *5.2.3.1 Trends in Tranche Thickness*

At the top of the section (see Section 5.2.1), four problems with the ratings-only model were flagged. The monotonicity issue was fixed by incorporating reinvestment horizon and the A3 dispersion was addressed (it has a compressed reinvestment horizon). The Baa3 tranche outliers remain an active point of concern, given that Baa3 has a standard average reinvestment horizon.

When plotting C-1 Factors by both reinvestment horizon and "tranche thickness," defined as detachment point (DP) minus attachment point (AP), two clear patterns emerge, particularly in the Baa3 tranche:

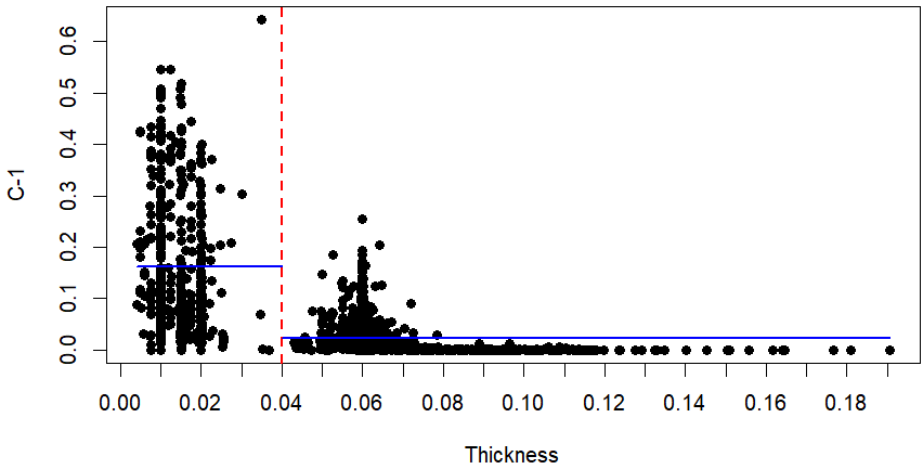
(1) As previously evidenced, C-1 increases as the reinvestment end date moves further out
(2) C-1 is generally greater for thinner tranches, with a clear delineation at ~4% thickness

**Figure 10 - Baa3 Raw C-1 Factors vs. Reinvestment Horizon and Tranche Thickness (Bubble Size Indicates C-1 Factor)**




When creating a dividing line at 4% and averaging the Raw C-1 Factors for the tranches with ≤4% thickness and with >4%, the delineation in the two groups is even more striking.

**Figure 11 - Baa3 Raw C-1 Factors vs. Tranche Thickness**




There are no Baa3 bonds that have a thickness between 3.68% and 4.29%; this gap separates two distinct types of Baa3 CLOs. Upon further investigation and from consultation with experts, the Academy learned that the thin tranche is the product of a unique CLO structure that capitalizes on "first-dollar-of-loss" rating methodology. Presented in Table 8 are two CLOs. The "Traditional CLO" has a single Baa3 tranche that roughly covers the ~12–18% range. The Ba3 tranche sits below at the ~8–12% range and the A2 tranche sits above at ~18–24%. To the right is the "Split-BBB CLO." This structure similarly has A2 cover the ~18–24% range and has Baa3 cover the ~12–18% range. The difference lies in the Ba3 tranche. Instead of covering ~8–12%, it covers ~8–11% with a secondary Baa3 tranche in that thin ~11–12% range.

**Table 8 - Comparison of CLO Attachment and Detachment Points**

| Traditional CLO | | | | Split-BBB CLO | | | |
|---|---|---|---|---|---|---|---|
| **Tranche Name** | **Rating** | **Attachment Point** | **Detachment Point** | **Tranche Name** | **Rating** | **Attachment Point** | **Detachment Point** |
| A1R | Aaa | 37.1% | 100.0% | AR2 | Aaa | 35.9% | 100.0% |
| A1J | Aaa | 35.1% | 37.1% | BR2 | Aa2 | 23.9% | 35.9% |
| A2R | Aa2 | 24.1% | 35.1% | CR2 | A2 | 17.9% | 23.9% |
| BR | A2 | 18.5% | 24.1% | D1R2 | Baa3 | 11.8% | 17.9% |
| CR | Baa3 | 12.6% | 18.5% | D2R2 | Baa3 | 10.8% | 11.8% |
| DR | Ba3 | 8.1% | 12.6% | ER2 | Ba3 | 7.8% | 10.8% |
| PS | NR | 0.0% | 8.1% | PS1 | NR | 0.0% | 7.8% |

If a CLO is rated with "first-dollar-of-loss" methodology, then the severity does not drive the charge; the probability of penetration does. The 11% attachment point for the Split-BBB CLO sits just high enough that its probability of penetration falls in the Baa3 range. But when accounting for severity, the risk for this CLO tranche is much higher than a Traditional Baa3 CLO tranche that detaches at 18%. The "thin" (defined as ≤4% thickness) Baa3 requires only a 12% loss on total collateral to be fully wiped out, while the "thick" (defined as >4% thickness) Baa3 requires an additional 6% of total collateral to be lost in order to be fully wiped out.

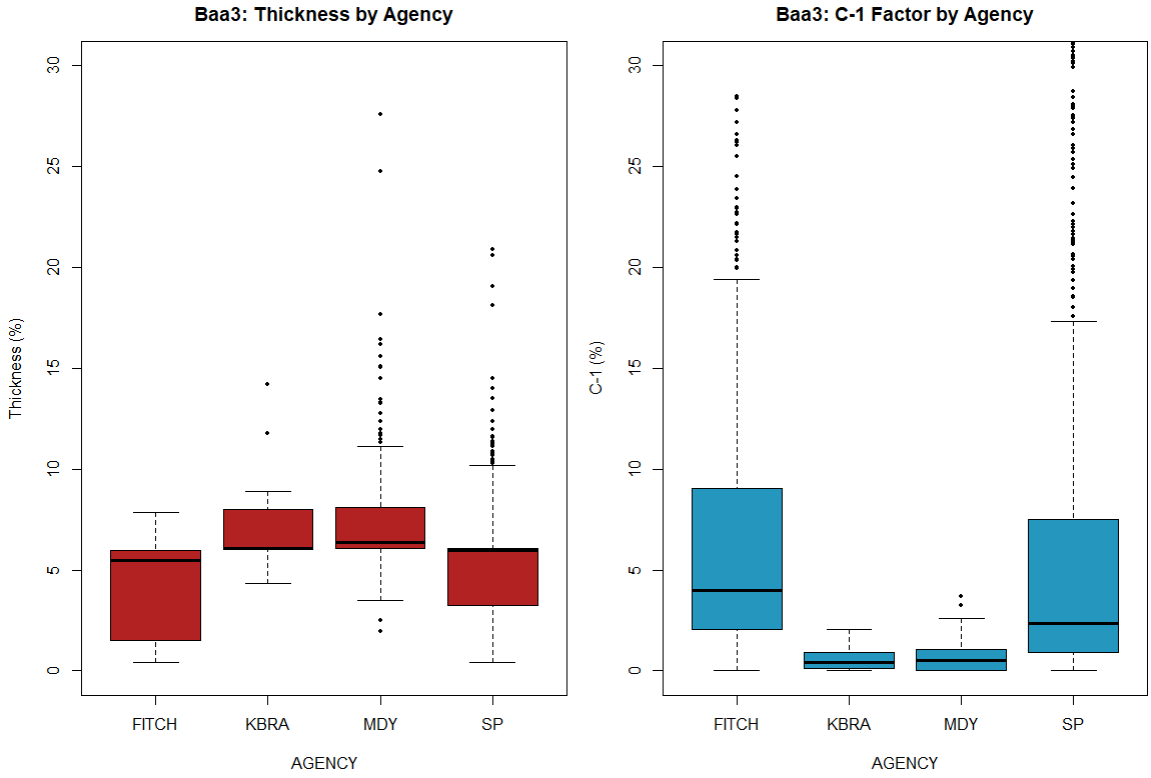
#### *5.2.3.2 Impact of Agency Rating Methodology on Tranche Thickness*

This is further illustrated when analyzing the tranche thickness and Raw C-1 Factors by rating agency. S&P and Fitch rate CLOs based on first-dollar-of-loss while Moody's and KBRA rate based on expected losses, which includes assumptions on severity.

The box plots in Figure 12 show the interquartile range (IQR) for each agency. The S&P and Fitch IQRs for tranche thickness sit almost entirely below the Moody's and KBRA IQRs. This means the 25$^{th}$ percentile of tranche thickness for Baa3 ratings from Moody's/KBRA is *as large* as the 75$^{th}$ percentile of tranche thickness for Baa3 ratings from S&P/Fitch. It appears from the data that CLO managers enacting this structure seek ratings from S&P and Fitch to get the extra Baa3 rating. Meanwhile, Moody's/KBRA require the tranches to have the higher detachment point (and thus higher thickness) in order to qualify for the Baa3 rating.

The inverse pattern is reflected in the Raw C-1 Factors. Since S&P/Fitch's Baa3 ratings contain more thin tranches, their Baa3 C-1 Factors skew towards higher risk, given the higher expected severity. The charts are capped at 30% for visualization; not shown are the maximum Fitch and S&P factors, 54.6% and 64.2%, respectively. By contrast, KBRA and Moody's have maximum C-1 Factors of 2.1% and 3.7%, respectively. Similar to the chart with the tranche thickness, the S&P/Fitch IQRs sit almost entirely above the Moody's/KBRA IQRs, once again reaffirming that these are two distinct groups.

**Figure 12 - Baa3 Tranche Thickness and Raw C-1 Factor by Rating Agency**




To address this phenomenon, the Academy proposes two sets of charges based on tranche thickness. The proposed factors use 4% as the cutoff point, as shown above. This decision is not analytical; 4% is chosen because it is a round number in that range between the two clusters of Baa3 bonds and avoids the pitfall of false precision.

As shown in Appendix H and Appendix I, the gap between Raw C-1 Factors for "thin" and "thick" tranches persists through the lower credit quality. However, the logic used to choose 4% does not neatly apply for those ratings. Ba3, the rating with the most observations below Baa3, has a cluster of bonds issued with 4% thickness. There is a minor cluster of bonds with 4.5% thickness.

For this iteration of the model, the Academy chooses 4% as the cutoff point, to maintain simplicity and avoid false precision. While the analysis is anchored to a 4% cutoff point, the Academy recommends that 4.25% be considered as an alternative cutoff point since 4.25% sits neatly between the 4% and 4.5% peaks observed in Ba3 and still falls in the range of points where Baa3 has no observations. Appendix I presents a detailed comparison of the two options. There is no impact on Baa3 (since there are no observations between 4% and 4.25% thickness). The 4.25% cutoff does better differentiate the risks for Ba3, increasing the gap between "thin" and "thick" charges by over 3 percentage points.

Furthermore, the Academy notes that the tranche thickness analysis is based on the universe of CLOs analyzed. The tranche thickness cutoff point and relevance should be reevaluated if CLO structures materially evolve in the future.

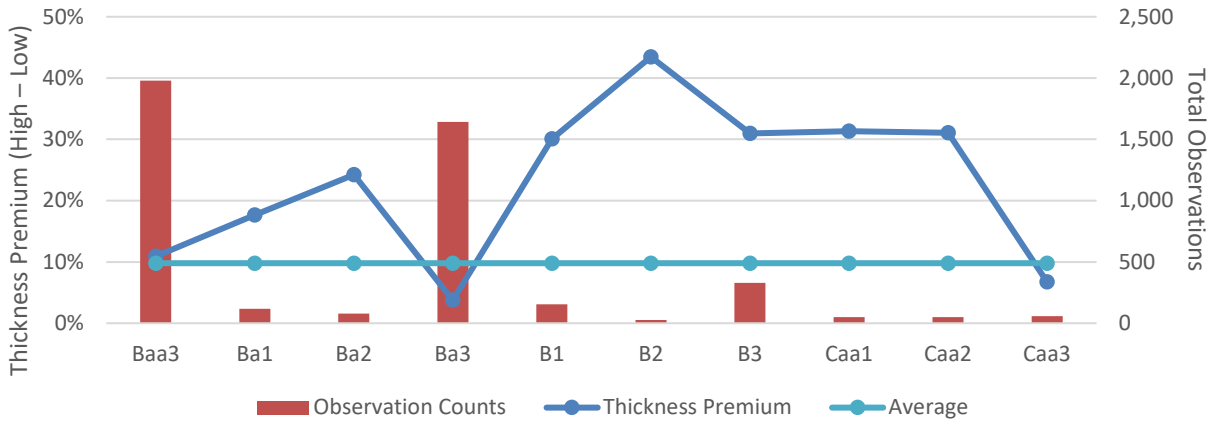
### 5.2.4 Tranche Thickness (Thick vs. Thin) as a Comparable Attribute

The numbers of "thin" Baa1 and Baa2 tranches are 15 and 14, respectively. These are too infrequent to be credible, so the Academy elects to only evaluate the effect of thickness on C-1 Factors for ratings Baa3 and below.

In the OLS framework, the Academy regresses C-1 against rating, reinvestment horizon (and the interaction terms) and dummy (indicator) variables for thickness ≤ 4% with rating Baa3/below. The coefficients on the "thin tranche" dummy variables are denoted the "thickness premium" since the coefficient indicates how much the C-1 Factor increases for thickness ≤ 4% (compared to thickness > 4%).

The Academy observes that the thickness premium varies across ratings. However, the data is thin for tranches below Ba3. Furthermore, when thickness premium is averaged across ratings Baa3 and below, it is roughly equal to the thin Baa3 premium at ~10%. The Academy concludes that using a single premium for thin Baa3/below debt is sufficient; it does not materially under- or overestimate the premium for the Baa3 level and it reduces the noise for lower-quality debt, where there are fewer observations.

**Figure 13 - Distribution of Thin Tranches (≤4%) by Rating**




The resulting OLS output is as follows:

**Figure 14 - Regression Results Final C-1 Factor Model**

```
Residuals:
     Min       1Q   Median       3Q      Max
-0.70926 -0.00145 -0.00037  0.00031  0.84095

Coefficients:
                      Estimate Std. Error t value Pr(>|t|)
Aaa                  6.039e-04  1.788e-03   0.338   0.7356
Aa1                  3.094e-03  4.138e-03   0.748   0.4547
Aa2                  4.661e-04  2.672e-03   0.174   0.8615
Aa3                 -3.794e-05  8.282e-03  -0.005   0.9963
A1                   3.657e-03  4.713e-03   0.776   0.4378
A2                   6.176e-04  2.863e-03   0.216   0.8292
A3                  -2.676e-03  1.069e-02  -0.250   0.8024
Baa1                 9.042e-04  6.104e-03   0.148   0.8822
Baa2                 9.849e-03  5.556e-03   1.773   0.0763 .
Baa3                -1.735e-02  2.705e-03  -6.416 1.45e-10 ***
Ba1                  8.131e-02  6.768e-03  12.014  < 2e-16 ***
Ba2                  1.647e-01  7.998e-03  20.588  < 2e-16 ***
Ba3                  1.286e-01  2.845e-03  45.206  < 2e-16 ***
B1                   1.562e-01  5.507e-03  28.356  < 2e-16 ***
B2                   2.477e-01  1.342e-02  18.461  < 2e-16 ***
B3                   4.999e-01  7.064e-03  70.771  < 2e-16 ***
Caa1                 5.079e-01  9.850e-03  51.564  < 2e-16 ***
Caa2                 5.787e-01  9.871e-03  58.624  < 2e-16 ***
Caa3                 7.349e-01  9.033e-03  81.356  < 2e-16 ***
REINV_END_DATE      -1.115e-02  2.000e-03  -5.575 2.53e-08 ***
REINV_END_DATE_1     1.102e-02  2.087e-03   5.281 1.31e-07 ***
REINV_END_DATE_2     1.097e-02  2.169e-03   5.055 4.37e-07 ***
REINV_END_DATE_3     1.132e-02  2.191e-03   5.168 2.40e-07 ***
REINV_END_DATE_4     1.832e-02  2.491e-03   7.354 2.04e-13 ***
REINV_END_DATE_5     2.977e-02  2.170e-03  13.721  < 2e-16 ***
REINV_END_DATE_6     5.467e-02  2.251e-03  24.282  < 2e-16 ***
LOW_QUAL_LOW_THICK   9.795e-02  2.780e-03  35.233  < 2e-16 ***
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Residual standard error: 0.06828 on 12859 degrees of freedom
Multiple R-squared:  0.8618,    Adjusted R-squared:  0.8615
F-statistic:  2970 on 27 and 12859 DF,  p-value: < 2.2e-16
```

Security rating

Reinv horizon

Interaction terms

Quality and thickness

The "LOW_QUAL_LOW_THICK" variable is a dummy equal to 1 when thickness ≤ 4% and credit quality is Baa3 or below, as described above. Each rating is a dummy equal to 1 for bonds with that rating and equal to 0 otherwise. The REINV_END_DATE equals the average years to reinvestment end date and the subsequent interaction terms equal that average when the rating falls in the corresponding bucket (and equals 0 otherwise).

Consider the following examples as illustrations of the mathematical interpretation of the Final Regression C-1 Factor Model:

- Baa1: $0.0009 + 2.395 \times (-0.0111 + 0.0183) = 0.0181 = 1.81\%$
  - The factor for Baa1 is 0.0009.
  - The average reinvestment horizon (across all tranches) is 2.395.
  - The reinvestment horizon coefficient is −0.0111.
  - The reinvestment horizon interaction factor is 0.0183 for Bucket 4 (Baa1 is in Bucket 4).

- "Thick" Baa3: $-0.0174 + 2.395 \times (-0.0111 + 0.0298) = 0.0273 = 2.73\%$
  - The factor for Baa3 is −0.0174.
  - The average reinvestment horizon (across all tranches) is 2.395.
  - The reinvestment horizon coefficient is −0.0111.
  - The reinvestment horizon interaction factor is 0.0298 for Bucket 5 (Baa3 is in Bucket 5).

- "Thin" Baa3: $-0.0174 + 2.395 \times (-0.0111 + 0.0298) + 0.0980 = 0.1253 = 12.53\%$
  - Factors are identical to the "thick" Baa3 charge, except that the premium for thin tranches with rating Baa3/below (0.0980) is added.

Applying this logic to all ratings, splitting out for thickness, results in the following factors:

**Table 9 - Modeled C-1 Factors Prior to Isotonic Regression**

| Rating | Simple Average Raw C-1 Factors | Modeled C-1 Factors | |
|---|---|---|---|
| | | Thickness > 4% | Thickness ≤ 4% |
| Aaa | 0.03% | **0.03%** | |
| Aa1 | 0.28% | **0.27%** | |
| Aa2 | 0.00% | **0.00%** | |
| Aa3 | 0.00% | **0.04%** | |
| A1 | 0.40% | **0.41%** | |
| A2 | 0.11% | **0.10%** | |
| A3 | 0.12% | **1.45%** | |
| Baa1 | 1.58% | **1.81%** | |
| Baa2 | 3.02% | **2.70%** | |
| Baa3 | 5.94% | **2.73%** | **12.52%** |
| Ba1 | 20.70% | **12.59%** | **22.39%** |
| Ba2 | 27.37% | **20.93%** | **30.72%** |
| Ba3 | 28.92% | **23.28%** | **33.08%** |
| B1 | 17.34% | **26.04%** | **35.84%** |
| B2 | 30.81% | **35.20%** | **44.99%** |
| B3 | 56.39% | **47.32%** | **57.12%** |
| Caa1 | 57.60% | **48.12%** | **57.92%** |
| Caa2 | 66.51% | **55.20%** | **64.99%** |
| Caa3 | 77.33% | **70.82%** | **80.61%** |

For most ratings, the results are salutary. The Modeled C-1 Factors generally improve the monotonicity relative to the simple average of Raw C-1 Factors without meaningfully deviating in magnitude. For the ratings with two modeled factors, the simple average generally sits in the middle of the "thick" and "thin" tranche factors. B1, B2 and Caa2 constitute the exceptions, but these are expected because those three are the ratings for which average reinvestment horizon is noticeably shorter than that of the adjacent ratings (Ba3, B3, Caa1 and Caa3), as previously illustrated.

Appendix G presents the adjusted $R^2$ for this regression along with all the other regressions considered. This one has an adjusted $R^2$ of 83.25%. Earlier, tranche coupon was identified as a possible explanatory covariate. After adding the flag for 4% thickness, the coupon only increases adjusted $R^2$ to 83.71%, less than half a percent. **The marginal increase in explanatory power suggests that rating, reinvestment horizon and tranche thickness are sufficiently explanatory by themselves, producing coherent Modeled C-1 Factors.**

### 5.2.5 Modeling A3 and Above Tranches

#### *5.2.5.1 Bayesian Frequency/Severity Technique*

The remaining concern lies within the A3/above factors, specifically Aa2–A2 where monotonicity fails to materialize. This could indicate that additional comparable attributes are required to explain the factors. However, the cause of this break in monotonicity appears to be benign, driven by standard error.

**Table 10 - Raw vs. Modeled C-1 Factors for A3 and Above**

| | Total Observations | Non-Zero C-1 Observations | Average Raw C-1 Factors | Modeled C-1 Factors |
|---|---|---|---|---|
| Aaa | 3,701 | 2 | 0.03% | 0.03% |
| Aa1 | 297 | 1 | 0.28% | 0.27% |
| Aa2 | 1,879 | 1 | 0.00% | 0.00% |
| Aa3 | 68 | 0 | 0.00% | 0.04% |
| A1 | 246 | 73 | 0.40% | 0.41% |
| A2 | 1,642 | 844 | 0.11% | 0.10% |
| A3 | 41 | 5 | 0.12% | 1.45% |

Aa2 and Aa3 both have simple average Raw C-1 Factors that round to 0.00% with a solitary non-zero observation (out of 1,947 total observations). Even A1, which has 73 non-zero observations, still has credibility concerns when compared to A2, which has over 11 times as many non-zero observations.

A clean potential solution involves Bayesian statistics. As demonstrated in Appendix L, the expected value of non-zero C-1 frequency can be estimated as the number of non-zero observations + 1 divided by the total observations + 2. We can estimate the "implied severity" of non-zero C-1 by taking the ratio of average C-1 to the non-zero frequency. When estimating the "adjusted" Raw C-1 Factors, the Bayesian "expected non-zero frequency" can be multiplied by some estimate of severity. Illustrated in the table are two approaches to severity: using the implied severity from real observations and using the average A3/above severity for all ratings (the average is used in both approaches for Aa3 because it has no non-zero observations).

**Table 11 - Bayesian Adjustment for A3 and Above C-1 Factors**

| | Total Observs | Non-Zero C-1 Observs | Average C-1 Factors | Non-Zero Frequency | Implied Severity | Expected Non-Zero Frequency | Adjusted C-1 (implied severity) | Adjusted C-1 (average severity) |
|---|---|---|---|---|---|---|---|---|
| Aaa | 3,701 | 2 | 0.03% | 0.05% | 55.52% | 0.08% | 0.04% | 0.00% |
| Aa1 | 297 | 1 | 0.28% | 0.34% | 83.16% | 0.67% | 0.56% | 0.00% |
| Aa2 | 1,879 | 1 | 0.00% | 0.05% | 0.00% | 0.11% | 0.00% | 0.00% |
| Aa3 | 68 | 0 | 0.00% | 0.00% | N/A | 1.43% | 0.01% | 0.01% |
| A1 | 246 | 73 | 0.40% | 29.67% | 1.35% | 29.84% | 0.40% | 0.15% |
| A2 | 1,642 | 844 | 0.11% | 51.40% | 0.21% | 51.40% | 0.11% | 0.27% |
| A3 | 41 | 5 | 0.12% | 12.20% | 0.98% | 13.95% | 0.14% | 0.07% |
| Total | 7,874 | 926 | 0.06% | 11.76% | 0.52% | 11.77% | 0.06% | 0.06% |

It is apparent that this proposal will not solve the problem. While the Aa3 expected frequency is rightly higher than the Aa1 expected frequency (this fixes the Aa3 observed frequency being lower), the Aa2 expected frequency is considerably lower than the Aa1 expected frequency.

Furthermore, the implied severities are closer to 0 for single-A credit, because there are more partial penetrations where the loss is close to, but not exactly, 0. This would suggest that a simple average severity is not appropriate. Unfortunately, the A3/above implied severities do not neatly trend in one direction. If they trended downwards, a curve could be fit to approximate average severity. But as it is, the implied severities are noisy and not credible. Including single-A likely understates the severity for AAA and AA, but excluding single-A would render results that are not statistically credible (since there are only four observations).

#### *5.2.5.2 Isotonic Regression*

For these reasons, the Academy concludes that there are insufficient data points to estimate the "true" average Raw C-1 Factor for each A3/above rating. To fix the monotonicity problem, the Academy instead proposes an isotonic regression to compel the Modeled C-1 Factors to increase as credit quality declines. This effectively credibility-weights the factors and relies on real data, reducing the risk of overfitting.

An **isotonic regression** (see Appendix M) forces monotonicity by taking weighted averages of adjacent points. A1, for example, has a Modeled C-1 Factor (after adjusting for reinvestment horizon) of 0.41%. It sits above A2 (in quality), which has a Modeled C-1 Factor of 0.10%. Taking a weighted average—weighting by the number of observations—forces both A1 and A2 to have a factor of:

$$\frac{0.41\% \times 246 + 0.10\% \times 1{,}642}{246 + 1{,}642} = 0.14\%$$

The resulting factors are:

**Table 12 - Final Modeled Debt C-1 Factors**

| Rating | Simple Average Raw C-1 Factors | Modeled C-1 Factors | |
|---|---|---|---|
| | | Thickness > 4% | Thickness ≤ 4% |
| Aaa | 0.03% | **0.03%** | |
| Aa1 | 0.28% | **0.04%** | |
| Aa2 | 0.00% | **0.04%** | |
| Aa3 | 0.00% | **0.04%** | |
| A1 | 0.40% | **0.14%** | |
| A2 | 0.11% | **0.14%** | |
| A3 | 0.12% | **1.45%** | |
| Baa1 | 1.58% | **1.81%** | |
| Baa2 | 3.02% | **2.70%** | |
| Baa3 | 5.94% | **2.73%** | **12.52%** |
| Ba1 | 20.70% | **12.59%** | **22.39%** |
| Ba2 | 27.37% | **20.93%** | **30.72%** |
| Ba3 | 28.92% | **23.28%** | **33.08%** |
| B1 | 17.34% | **26.04%** | **35.84%** |
| B2 | 30.81% | **35.20%** | **44.99%** |
| B3 | 56.39% | **47.32%** | **57.12%** |
| Caa1 | 57.60% | **48.12%** | **57.92%** |
| Caa2 | 66.51% | **55.20%** | **64.99%** |
| Caa3 | 77.33% | **70.82%** | **80.61%** |

**Figure 15 - Comparison of Raw C-1 Factors vs. Proposed Modeled C-1 Factors**




## 5.2.6 Credibility-Weighting Proposed Reinvestment Horizon Adjustments

In Section 5.2.2.2, the Academy accounts for reinvestment horizon and considers two methods for bucketing ratings together, for the purpose of estimating variable interactions. The more conservative approach (resulting in higher C-1), "Proposed Buckets," was used to develop the tranche thickness and isotonic regression models. However, when the Academy re-runs the full script (including tranche thickness parameters and isotonic regression) with the "Alternative Buckets" methodology, the same proposed C-1 Factors are produced, *except* for A3.

Because the resulting A3 factors are quite different, credibility-weighting is appropriate. The Academy

considers the **Akaike Model Averaging** method of credibility-weighting.[22] This method produces credibility weights from the log-likelihood statistics and degrees of freedom. A model's fit is better when it has greater log-likelihood and fewer degrees of freedom, which is reflected in the Akaike Information Criterion (AIC). A model's credibility is greater when its AIC is more negative: when it has the least "information loss." Thus, credibility weights can be derived from AIC.

For the two models considered, the log-likelihoods are:

$$ll_{proposed} = 16{,}316.88 \qquad ll_{alternative} = 16{,}317.14.$$

Because the two models use the same degrees of freedom, it follows that

$$w_{proposed} = \frac{1}{1+e^{ll_{alternative}-ll_{proposed}}} = \frac{1}{1+e^{0.26}} = 44\% \qquad w_{alternative} = 1 - w_{proposed} = 56\%.$$

This would imply a credibility-weighted C-1 Factor for A3 of

$$44\% \times 1.45\% + 56\% \times 0.16\% = 0.72\%.$$

Because both log-likelihood estimates round to 16,317, the Academy concludes that the difference in log-likelihoods may be attributable to random noise and that the simpler and more conservative 50/50 average is warranted. This produces a C-1 Factor for A3 of

$$50\% \times 1.45\% + 50\% \times 0.16\% = \mathbf{0.80}\%.$$

## 5.3 Modeled Equity C-1 Factors by Comparable Attributes

The Academy began the comparable attributes process for residual tranche equity by observing the dispersion of C-1 Factors.

[22] "AIC Model Selection Using Akaike Weights"; Psychonomic Bulletin & Review; 2004.

Figure 16 - Residual Tranche C-1: Allowable Earned Yield vs. Practical Expedient Distributions

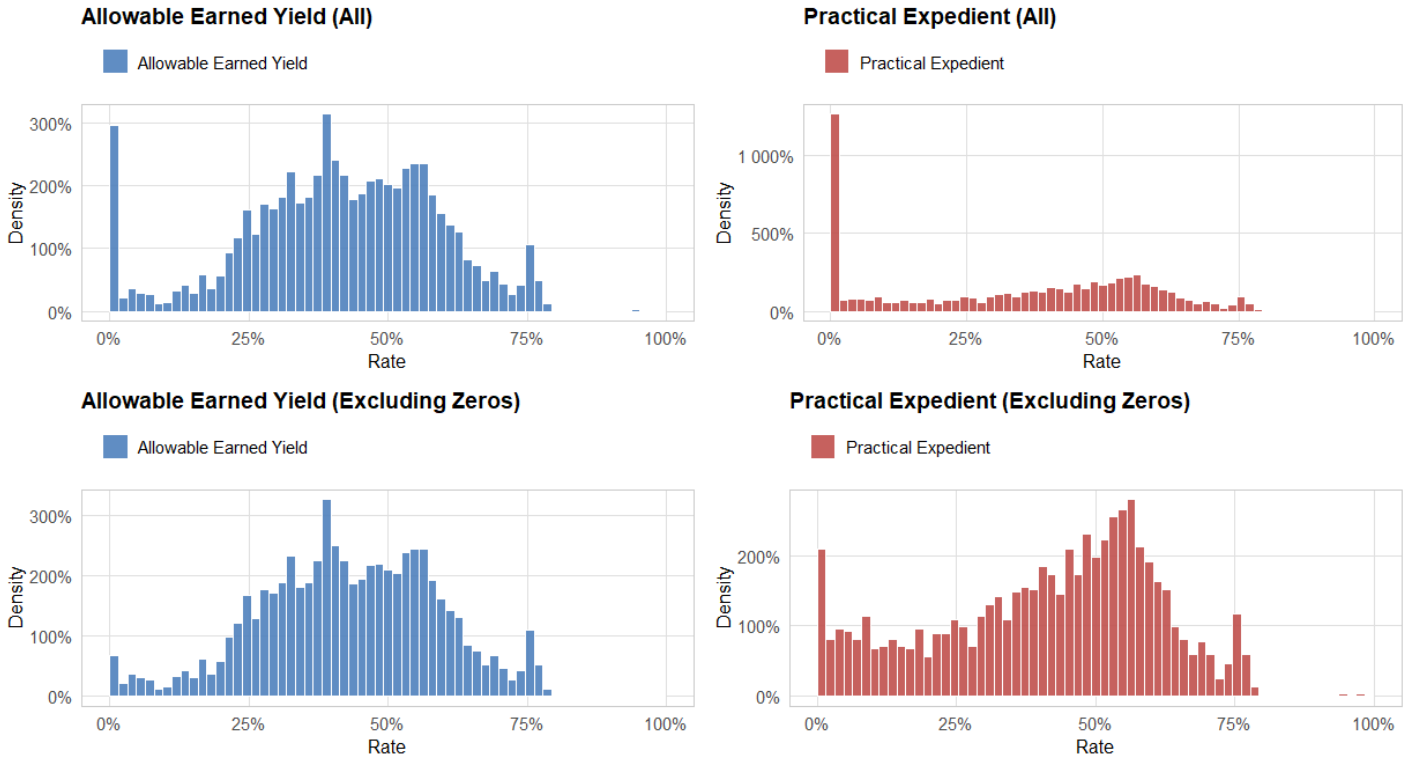



Table 13 - Residual Tranche Raw C-1 Distribution Statistics

| | SERIES | PROPORTION ZERO | MEAN | STD DEV | PERCENTILES 5TH | 10TH | 25TH | 50TH | 75TH | 90TH | 95TH |
|---|---|---|---|---|---|---|---|---|---|---|---|
| ALLOWABLE EARNED YIELD | Full Universe | 3.68% | 41.38% | 17.77% | 3.15% | 19.04% | 30.80% | 41.91% | 54.24% | 62.62% | 69.07% |
| | Excluding Zeros | | 42.96% | 16.12% | 15.84% | 23.26% | 32.24% | 42.90% | 54.63% | 62.99% | 69.19% |
| PRACTICAL EXPEDIENT | Full Universe | 17.26% | 33.98% | 23.94% | 0.00% | 0.00% | 8.39% | 38.72% | 54.12% | 62.39% | 68.90% |
| | Excluding Zeros | | 41.07% | 20.04% | 3.46% | 8.76% | 27.18% | 45.02% | 56.10% | 63.75% | 70.25% |

Unsurprisingly, the practical expedient accounting is more likely to result in a book value equal to 0 with no deficiency. When excluding the zero C-1 Factors, the two methods produce very similar factors. This too is unsurprising since the model's embedded conservatism produced low book yields and low book yields approach practical expedient accounting (the two are identical when book yield equals 0, as it does for nearly half of the modeled securities). As a result, the Academy chooses to study only practical expedient accounting. Both methods are valid and practical expedient invokes fewer modeling assumptions, which reduces the risk of added model error.

### 5.3.1 Considered Comparable Attributes

In consideration of stakeholder suggestions and internal discussions, the Academy first considered the following four comparable attributes:

1. Tranche detachment point: The proportion of losses needed to fully wipe out the residual tranche. A higher detachment point reduces the severity of loss.

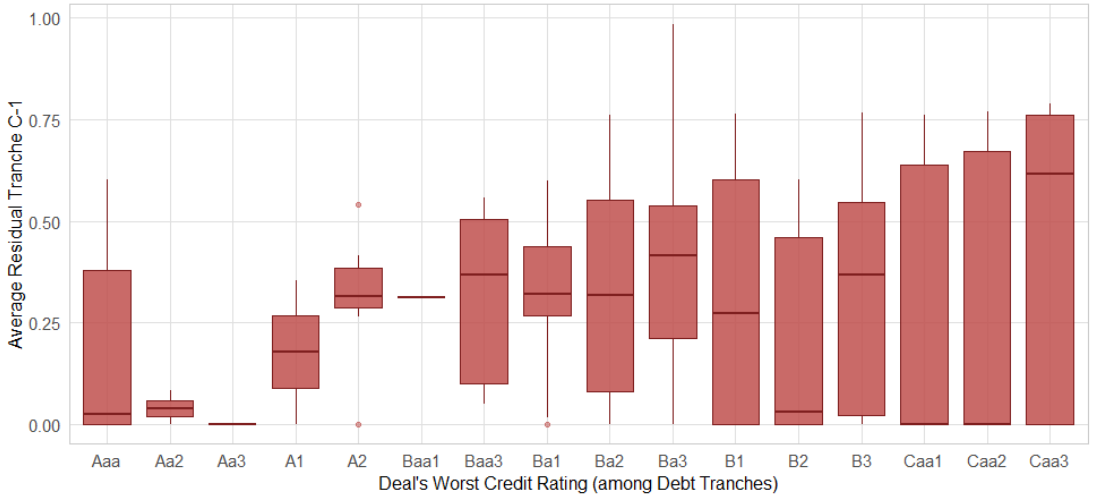
2. WARF: Weighted average rating factor, as defined by Moody's Analytics. A greater factor corresponds to riskier underlying loan credit, increasing tail risk for the residual tranche.

3. Interest/principal-to-face ratio: The ratio of total already paid interest/principal on the residual tranche to the residual tranche face value. This accounts for the fact that residual tranches become less risky as they mature and book value is paid off. When a large portion of face value has already been paid off, the residual tranche is more likely to break even.

4. Maximum rating number: The numeric rating (Aaa = 1, Aa1 = 2, etc.) corresponding to the CLO's lowest-rated debt tranche. CLOs with low-rated debt are expected to place greater risk on the equity tranche.

As shown in Appendix J, the maximum rating number is a poor predictor of C-1. This is further corroborated by Figure 17, which shows that CLOs whose lowest debt rating is Ba3 have higher average residual tranche Raw C-1 Factors than all other CLOs (except for the deals with Caa3 debt).

**Figure 17 - Boxplot of Residual Tranche C-1 against Worst Debt Rating**




It should be noted that 64.12% of residual tranche securities are part of a CLO whose worst rating is Ba3, so the boxplot is likely skewed by insufficient heterogeneity within the data set.

The Academy considered instead looking at the balance in low-quality ratings. For example, balance in Baa1/below would take the total balance of CLO debt tranches rated Baa1 or worse and divide by the CLO's total balance. This analysis is also shown in Appendix J. The Ba1/below variable has the most explanatory power among the considered thresholds. Detachment point and WARF are no longer statistically significant when the credit quality of the debt tranches is considered.

The Academy reasons that the interest/principal-to-face ratio is a proxy for maturity since a residual tranche closer to maturity will have received more interest than a recently issued residual tranche. Because the C-1 Factors are horizon-neutral, this variable can be set to the mean in any considered formulas. Considering Ba1/below balance as a comparable attribute produces the following formula (after setting the interest/principal-to-face ratio to mean):

$$\mathbf{27.86\% + 1.243 \times} \boldsymbol{\textit{Proportion of Ba1/below Balance.}}$$

Two issues emerge when looking at Figure 18 and Figure 19. First, the proportion of Ba1/below balance is concentrated in the small range of (2.5%, 4.5%). Most CLOs—85.67%, to be exact—contain less than 7% of balance in tranches rated Ba1 or below. This means that for 85% of the residual tranches, the C-1 Factor would only range from 27.86% to 36.56%, less than a 10-percentage-point range. Furthermore, the C-1 Factors do not exhibit any clear linear relationship with this attribute. The attribute adds a minor statistical improvement that is dwarfed by the unexplained random noise. For these reasons, the Academy concludes that there is not good evidence in favor of adding a comparable attribute for residual tranche equity.

**Figure 18 - Distribution of Proportion of Balance in Ba1/below Credit**

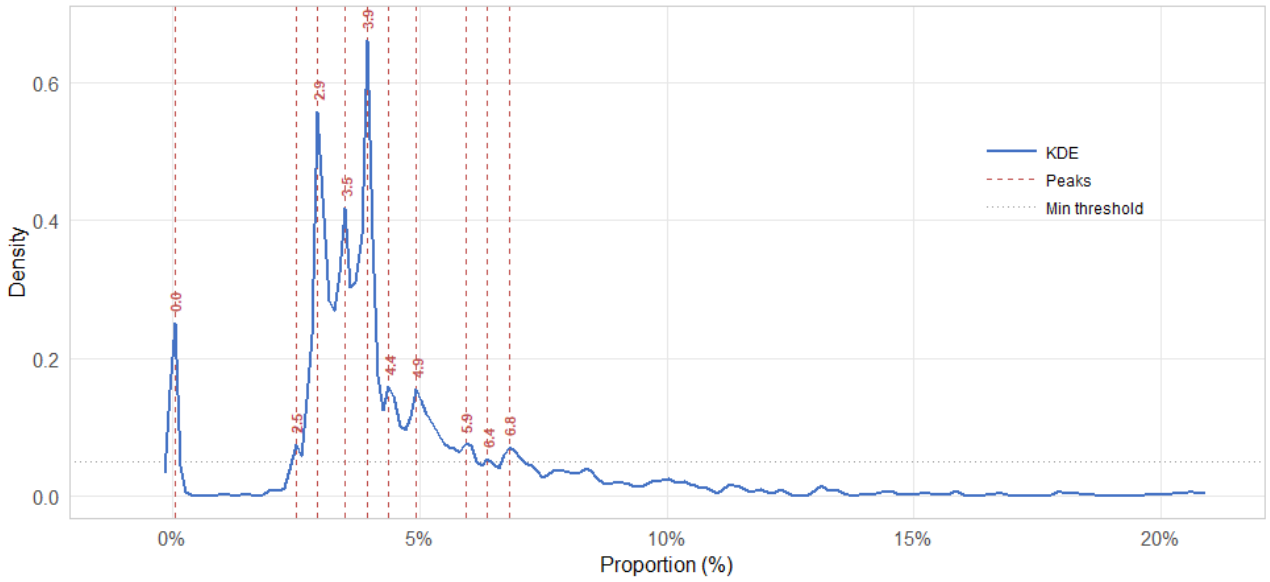
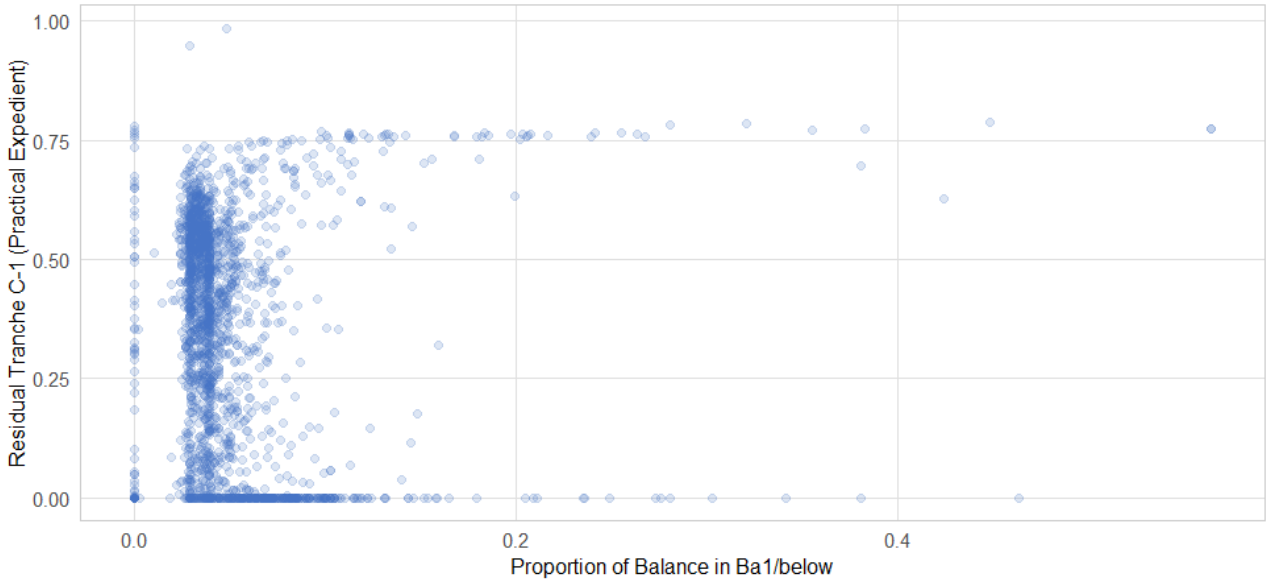



**Figure 19 - Residual Tranche C-1 vs. Proportion of Balance in Ba1/below Credit**



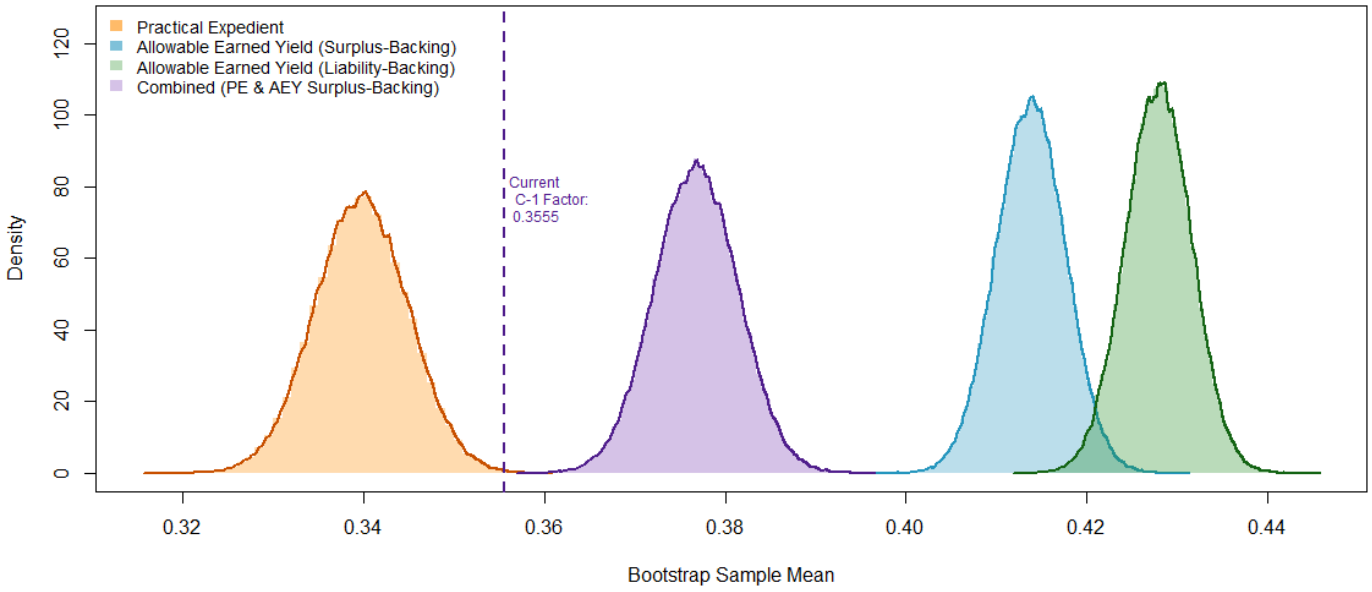
### 5.3.2 Comparing Average C-1 to Existing Factors

Because the residual tranche C-1 Factors are erratic and do not exhibit patterns like the debt C-1 Factors, the Academy must decide if the evidence in favor of changing the residual tranche factor is even statistically significant.

At the time of this research, the current post-tax residual tranche factor is 35.55%. The modeled range provided in Section 5.3.1 is 27.86% to 36.56%, which includes 35.55%.

The other consideration is sampling error. To estimate the distribution of sample mean, the Academy implements bootstrapping. The three residual tranche accounting methods are plotted. The "combined" histogram represents the average distribution of practical expedient and AEY (surplus-backing).

**Figure 20 - Distribution of Estimated Residual Tranche C-1 Means, by Accounting Method**




The current 35.55% factor lands between the two accounting methods. The p-value for practical expedient accounting is 0.2%. This indicates that sampling error *alone* does not explain deviation from the 35.55% benchmark. However, sampling error is not the only error within the analysis; the scenario selection (of the 17 tail scenarios) introduces error along with the parameter selection. For these reasons, the Academy concludes that the current 35.55% factor is plausibly within the range of potential average Raw C-1 Factors for residual tranches.

Due to the inconclusive nature of this analysis, the Academy suggests retaining the status quo until better evidence is presented in favor of changing residual tranche factors.

# 6 Final C-1 Factors

The Academy concludes that the single most explanatory variable with respect to CLO tail risk is agency ratings. The Academy further observes that reinvestment horizon and tranche thickness are not fully captured within the agency ratings, leaving room for additional modifications.

The modeled factors are derived from an ordinary least squares regression of C-1 against dummy variables for rating, against reinvestment horizon with interaction terms by rating and against a dummy variable indicating thickness $\leq 4\%$ and rating Baa3/below. This regression has an adjusted $R^2$ of 83.25%.

## Table 14 - Final Regression Model for Proposed C-1 Factors (Proposed Buckets)

**Coefficients on Rating Dummy Variables:**

| Rating | Coefficient | Std. Error | t-value | p-value |
|---|---|---|---|---|
| Aaa | 0.0006 | 0.0018 | 0.34 | 0.74 |
| Aa1 | 0.0031 | 0.0041 | 0.75 | 0.45 |
| Aa2 | 0.0005 | 0.0027 | 0.17 | 0.86 |
| Aa3 | 0.0000 | 0.0083 | 0.00 | 1.00 |
| A1 | 0.0037 | 0.0047 | 0.78 | 0.44 |
| A2 | 0.0006 | 0.0029 | 0.22 | 0.83 |
| A3 | -0.0027 | 0.0107 | -0.25 | 0.80 |
| Baa1 | 0.0009 | 0.0061 | 0.15 | 0.88 |
| Baa2 | 0.0098 | 0.0056 | 1.77 | 0.08 |
| Baa3 | -0.0174 | 0.0027 | -6.42 | 1.45E-10 |
| Ba1 | 0.0813 | 0.0068 | 12.01 | 4.53E-33 |
| Ba2 | 0.1647 | 0.0080 | 20.59 | 1.08E-92 |
| Ba3 | 0.1286 | 0.0028 | 45.21 | 0.00E+00 |
| B1 | 0.1562 | 0.0055 | 28.36 | 1.28E-171 |
| B2 | 0.2477 | 0.0134 | 18.46 | 3.96E-75 |
| B3 | 0.4999 | 0.0071 | 70.77 | 0.00E+00 |
| Caa1 | 0.5079 | 0.0099 | 51.56 | 0.00E+00 |
| Caa2 | 0.5787 | 0.0099 | 58.62 | 0.00E+00 |
| Caa3 | 0.7349 | 0.0090 | 81.36 | 0.00E+00 |

**Coefficients on Years to Reinvestment End Date:**

| Bucket | Coefficient | Std. Error | t-value | p-value |
|---|---|---|---|---|
| All Ratings | -0.0111 | 0.0020 | -5.57 | 2.53E-08 |
| Aaa | 0.0110 | 0.0021 | 5.28 | 1.31E-07 |
| Aa1 / Aa2 | 0.0110 | 0.0022 | 5.05 | 4.37E-07 |
| Aa3 / A1 / A2 | 0.0113 | 0.0022 | 5.17 | 2.40E-07 |
| A3 / Baa1 / Baa2 | 0.0183 | 0.0025 | 7.35 | 2.04E-13 |
| Baa3 / Ba1 / Ba2 | 0.0298 | 0.0022 | 13.72 | 1.52E-42 |
| Ba3 / B1 / B2 | 0.0547 | 0.0023 | 24.28 | 2.18E-127 |

**Coefficient on Low Quality / Low Thickness Dummy**

| Bucket | Coefficient | Std. Error | t-value | p-value |
|---|---|---|---|---|
| Thickness ≤ 4% Baa3/below | 0.0980 | 0.0028 | 35.23 | 1.12E-259 |

### Table 15 - Final Regression Model for Proposed C-1 Factors (Alternative Buckets)

**Coefficients on Rating Dummy Variables:**

| Rating | Coefficient | Std. Error | t-value | p-value |
|---|---|---|---|---|
| Aaa | 0.0006 | 0.0018 | 0.34 | 0.74 |
| Aa1 | 0.0031 | 0.0041 | 0.75 | 0.45 |
| Aa2 | 0.0005 | 0.0027 | 0.17 | 0.86 |
| Aa3 | 0.0000 | 0.0083 | 0.00 | 1.00 |
| A1 | 0.0037 | 0.0047 | 0.78 | 0.44 |
| A2 | 0.0006 | 0.0029 | 0.22 | 0.83 |
| A3 | 0.0011 | 0.0107 | 0.11 | 0.91 |
| Baa1 | 0.0006 | 0.0061 | 0.10 | 0.92 |
| Baa2 | 0.0094 | 0.0056 | 1.69 | 0.09 |
| Baa3 | -0.0174 | 0.0027 | -6.42 | 1.45E-10 |
| Ba1 | 0.0813 | 0.0068 | 12.01 | 4.51E-33 |
| Ba2 | 0.1647 | 0.0080 | 20.59 | 1.07E-92 |
| Ba3 | 0.1286 | 0.0028 | 45.21 | 0.00E+00 |
| B1 | 0.1562 | 0.0055 | 28.36 | 1.26E-171 |
| B2 | 0.2477 | 0.0134 | 18.46 | 3.93E-75 |
| B3 | 0.4999 | 0.0071 | 70.77 | 0.00E+00 |
| Caa1 | 0.5079 | 0.0098 | 51.57 | 0.00E+00 |
| Caa2 | 0.5787 | 0.0099 | 58.63 | 0.00E+00 |
| Caa3 | 0.7349 | 0.0090 | 81.36 | 0.00E+00 |

**Coefficients on Years to Reinvestment End Date:**

| Bucket | Coefficient | Std. Error | t-value | p-value |
|---|---|---|---|---|
| All Ratings | -0.0111 | 0.0020 | -5.57 | 2.53E-08 |
| Aaa | 0.0110 | 0.0021 | 5.28 | 1.31E-07 |
| Aa1 / Aa2 | 0.0110 | 0.0022 | 5.05 | 4.37E-07 |
| Aa3 / A1 / A2 | 0.0113 | 0.0022 | 5.17 | 2.38E-07 |
| A3 / Baa1 / Baa2 | 0.0185 | 0.0025 | 7.39 | 1.57E-13 |
| Baa3 / Ba1 / Ba2 | 0.0298 | 0.0022 | 13.72 | 1.51E-42 |
| Ba3 / B1 / B2 | 0.0547 | 0.0023 | 24.28 | 2.16E-127 |

**Coefficient on Low Quality / Low Thickness Dummy**

| Bucket | Coefficient | Std. Error | t-value | p-value |
|---|---|---|---|---|
| Thickness ≤ 4% Baa3/below | 0.0980 | 0.0028 | 35.23 | 1.12E-259 |

The final factors (for both methods) are derived by rating (split out by "thick" and "thin" tranches for Baa3/below). The dummy for the corresponding rating is set to 1 (all other rating dummies set to 0) with the dummy for low quality/low thickness set to 1 only for the "thin" Baa3/below tranches. For all ratings, the reinvestment horizon is set to the universe average, 2.395, so as to retain horizon neutrality. The resulting factors from the two regressions are averaged together (using simple average), which only has a material impact on A3. Proposed residual tranche factors are kept at current rates. The resulting factors are:

### Table 16 - Final Proposed Post-Tax C-1 Factors

| Rating | Proposed C-1 Factors | |
|---|---|---|
| | Thickness > 4% | Thickness ≤ 4% |
| Aaa | 0.03% | |
| Aa1 | 0.04% | |
| Aa2 | 0.04% | |
| Aa3 | 0.04% | |
| A1 | 0.14% | |
| A2 | 0.14% | |
| A3 | 0.80% | |
| Baa1 | 1.81% | |
| Baa2 | 2.70% | |
| Baa3 | 2.73% | 12.52% |
| Ba1 | 12.59% | 22.39% |
| Ba2 | 20.93% | 30.72% |
| Ba3 | 23.28% | 33.08% |
| B1 | 26.04% | 35.84% |
| B2 | 35.20% | 44.99% |
| B3 | 47.32% | 57.12% |
| Caa1 | 48.12% | 57.92% |
| Caa2 | 55.20% | 64.99% |
| Caa3 | 70.82% | 80.61% |
| Residual Tranche | 35.55% | |

Assuming a tax rate of 21% with 80% recovery for debt (100% recovery for equity), the Academy calculates the following pre-tax factors:

### Table 17 - Final Proposed Pre-Tax C-1 Factors

| Rating | Proposed C-1 Factors | |
|---|---|---|
| | Thickness > 4% | Thickness ≤ 4% |
| Aaa | 0.04% | |
| Aa1 | 0.05% | |
| Aa2 | 0.05% | |
| Aa3 | 0.05% | |
| A1 | 0.17% | |
| A2 | 0.17% | |
| A3 | 0.97% | |
| Baa1 | 2.18% | |
| Baa2 | 3.24% | |
| Baa3 | 3.28% | 15.05% |
| Ba1 | 15.14% | 26.91% |
| Ba2 | 25.15% | 36.93% |
| Ba3 | 27.99% | 39.76% |
| B1 | 31.30% | 43.07% |
| B2 | 42.31% | 54.08% |
| B3 | 56.88% | 68.65% |
| Caa1 | 57.84% | 69.61% |
| Caa2 | 66.34% | 78.12% |
| Caa3 | 85.12% | 96.89% |
| Residual Tranche | 45.00% | |

# 7 Portfolio Adjustment Factors (PAF)

Within the bond model, C-1 Factors were generated for a representative life insurance portfolio. Because issuer diversification affects tail risk, additional factors were generated to estimate the C-1 for insurers that hold more or fewer unique bond issuers than the representative portfolio. The factors are presented in brackets where the first 10 issuers get one factor and the next 90 get a different factor and so forth.

**Table 18 - Bond Model Portfolio Adjustment Factors**

| | Lower Bound | Upper Bound | Factor |
|---|---|---|---|
| *First 10* | 0 | 10 | 5.87 |
| *Next 90* | 10 | 100 | 1.53 |
| *Next 100* | 100 | 200 | 0.85 |
| *Next 300* | 200 | 500 | 0.85 |
| *501+* | 500 | | 0.82 |

Such an analysis of CLOs is not possible for the Academy due to operational limitations. Modeling diversification directly would require more simulations passed through CDOnet in order to estimate the correlations between CLO deals.

In lieu of direct modeling, the Academy seeks mathematical equivalence with the bond model.

For a CLO, the credit risk is driven by underlying loan issuers. Hence the Academy reasons that owning just one tranche of a CLO should receive the same PAF as owning the entire vertical slice—and thus it is fair to model the PAF or diversification at the deal level (i.e., as if the entire vertical slice is owned). This creates mathematical ease because the diversification of the underlying loans passes through directly to the CLO owner. If an insurer owns multiple CLOs, then the insurer gets the diversification benefits of the combined loan portfolios.

The Academy considered modeling different factors by rating or requiring a certain number of tranches to be held by deal for the deal to qualify for the PAF. The argument considered is that the credit risks across tranches may diversify differently than the credit risks across independent bond issuers. It is not clear that an Aa tranche will diversify against a Baa tranche to the same extent that two Baa tranches will diversify against one another. Furthermore, the concentration risk in the underlying data will not penetrate all tranches the same way. If a CLO is concentrated, that could have an outsized effect on the subordinated tranches.

The Academy ultimately decided against this path because: 1) the bond model does not distinguish by rating for PAF, even though similar arguments could be made; and 2) the operational constraints prevent the Academy from deriving credible statistically driven results.

## 7.1 Modeling CLO PAF

When constructing the 17 scenarios in the Collateral Model, the Academy jointly simulated defaults and recoveries for the full universe of loans and calculated the present value of the full loan universe. In other words, all C-1 calculations for CLOs depended on underlying defaults diversified at the universe level. After filtering down to the U.S. BSL CLOs used for comparable attributes and removing small equity securities from the loan collateral, the Academy observes that across the 2,074 CLOs analyzed, there are 1,957 unique loan issuers. If an insurer held a portfolio containing the full universe of loans underlying CLOs, their PAF would be 88.46% (using the formula from the ACLI/MA Bond Model).

The final CLO C-1 base factors represent the factors for an insurer owning this full universe portfolio, so any CLO PAF applied to a real-world insurance portfolio will be strictly greater than 1, adjusting the factors to a less diversified portfolio.

Because the CLOs have overlapping loan issuers in the underlying portfolios, the Academy first estimates the distribution of number of unique issuers per given number of CLO deals. For a single CLO deal, this is just the total number of unique issuers for the underlying loans. But for two CLOs, the Academy identifies all unique CLO deal pairs, calculates the number of unique loan issuers across both CLOs in each pair and reports the distribution. When addressing portfolios of 3+ CLO deals, there are many combinations, so the Academy randomly samples 10,000 combinations of unique CLOs, calculates the number of unique issuers for each and reports the distribution of the 10,000 simulations.

Given a fixed number of CLO deal holdings, the Academy estimates the distribution of the number of unique loan issuers underlying the CLOs. For each number, the Academy calculates the bond PAF that would be applied to those loans if the insurer owned them directly. The Academy then takes a weighted average based on the distribution to estimate the average PAF for the given number of CLOs.

The Academy defines two PAF metrics. First, *absolute* PAF is defined as the weighted average bond PAF for the loans underlying a portfolio of a given number of CLOs. Second, *relative* PAF is defined as the absolute PAF divided by the collateral universe PAF. The relative PAF assumes full diversification when holding a loan for every one of the 1,957 issuers in the collateral universe.

**Figure 21 - Distribution of Unique Loan Issuers per Given Number of CLOs**

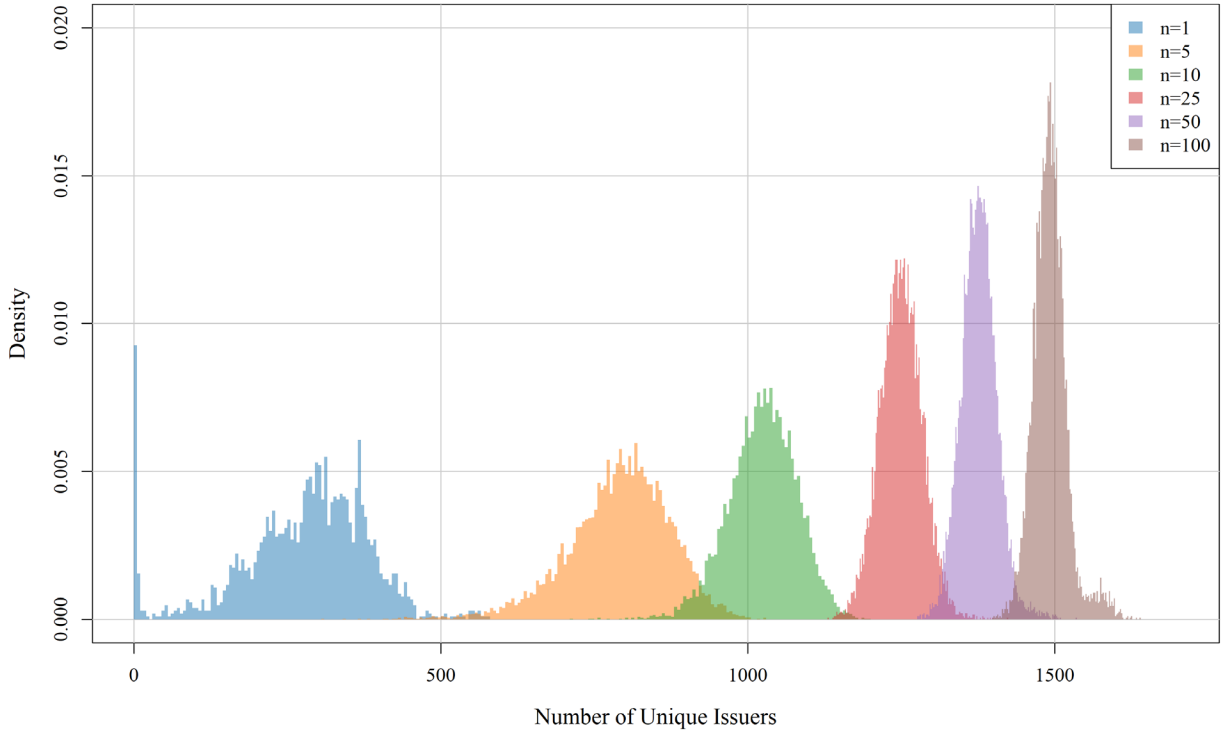
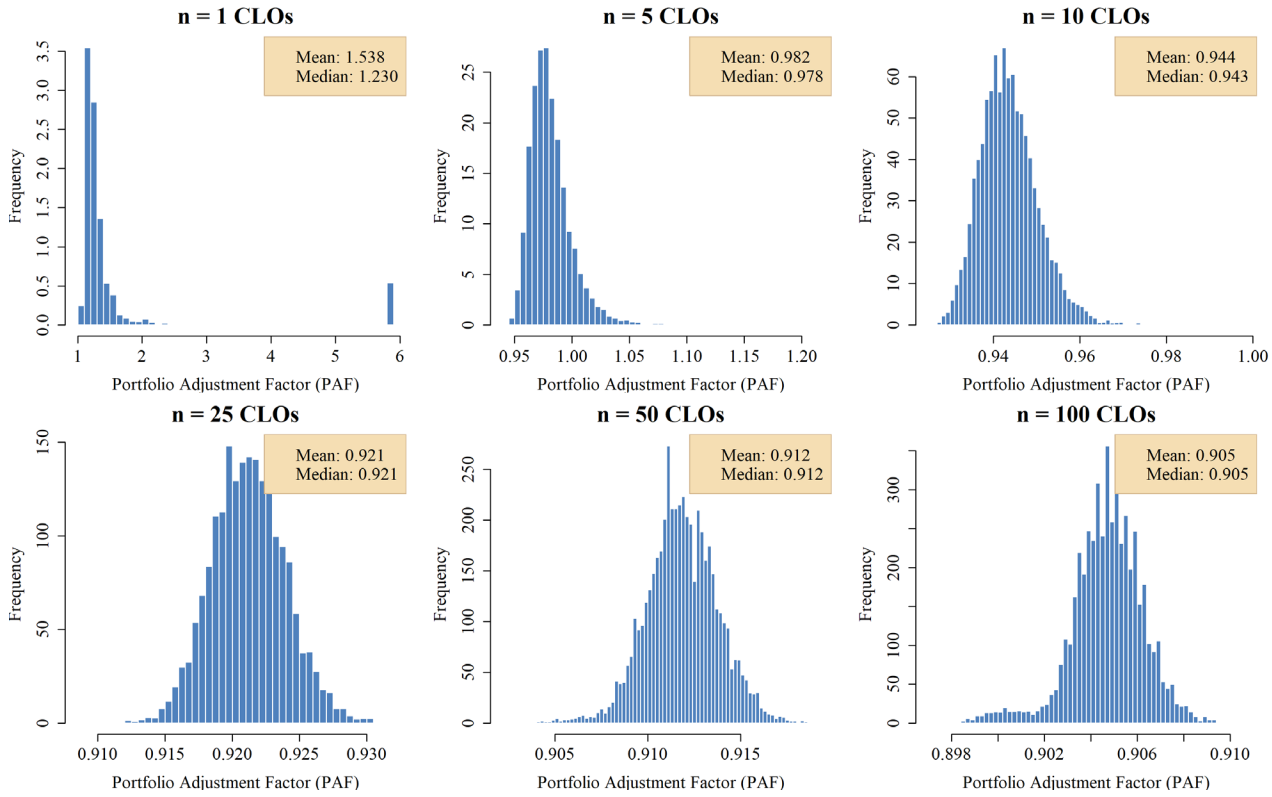
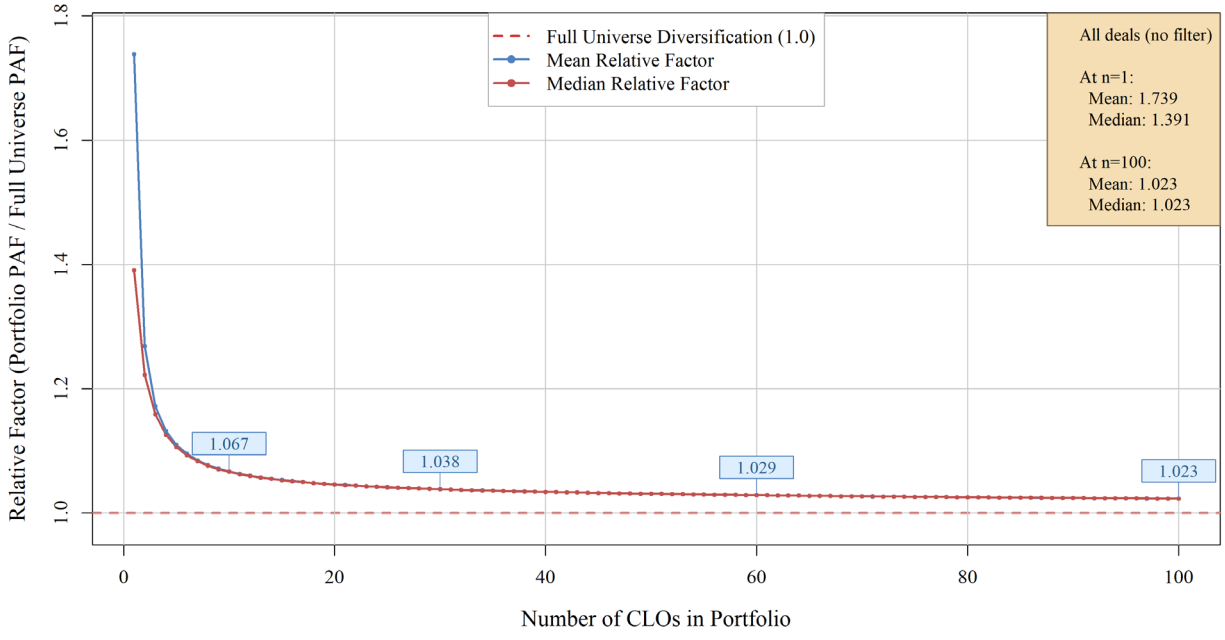


**Figure 22 - Distribution of Absolute PAFs by Number of CLOs**




Because the base factors are calculated using the fully diversified universe, the *relative* PAFs are the ratio of PAF to full-universe PAF.

**Figure 23 - Relative PAF Trend**



The Academy observes that the relative PAFs rapidly approach 1. The mean skews above the median for 1–3 CLOs but quickly converges. This is due to a handful of CLOs that have 10 or fewer underlying loan issuers. Those CLOs tend to be older and smaller, so they are not representative of the rest of the universe. The Academy recommends using the median relative PAF to avoid bias from this skew. For the first 10 combinations, the PAFs are as follows:

**Table 19 - Absolute vs. Median PAF for ≤10 CLOs**

| # Unique CLO Deals | Number of Companies* | Median Unique Loan Issuers | Median Absolute PAF | Median Relative PAF |
|---|---|---|---|---|
| 1 | 20 | 293 | 1.7386 | 1.3907 |
| 2 | 1 | 482 | 1.2686 | 1.2222 |
| 3 | 4 | 617 | 1.1712 | 1.1586 |
| 4 | 7 | 720 | 1.1319 | 1.1254 |
| 5 | 5 | 798 | 1.1097 | 1.1060 |
| 6 | 5 | 863 | 1.0951 | 1.0926 |
| 7 | 7 | 915 | 1.0848 | 1.0831 |
| 8 | 1 | 959 | 1.0772 | 1.0760 |
| 9 | 4 | 996 | 1.0714 | 1.0704 |
| 10 | 2 | 1,027 | 1.0668 | 1.0661 |

## 7.2 PAF Implication on Life Insurers

The Academy also seeks to estimate the real-world impact. Relying on 2024 year-end statutory filings and CLO identification based on third-party data sources,[23] the Academy identifies the number of unique CLOs owned by each insurer who owns at least one CLO. This analysis evaluates companies at the group level and does not distinguish between BSL and non-BSL CLOs, nor USD and non-USD CLOs. The Academy observes that a meaningful amount, 56 insurers, hold 10 or fewer CLOs. But the median number of CLOs owned is 40, with the average dragged up by six insurers who own over 500 unique deals.

[23] Sources: S&P Global, Kanerai, Intex, Barclays Research, Pitchbook, JP Morgan, Neuberger.

**Figure 24 - Distribution of Number of Unique CLOs, Life Insurers (Group Level)**

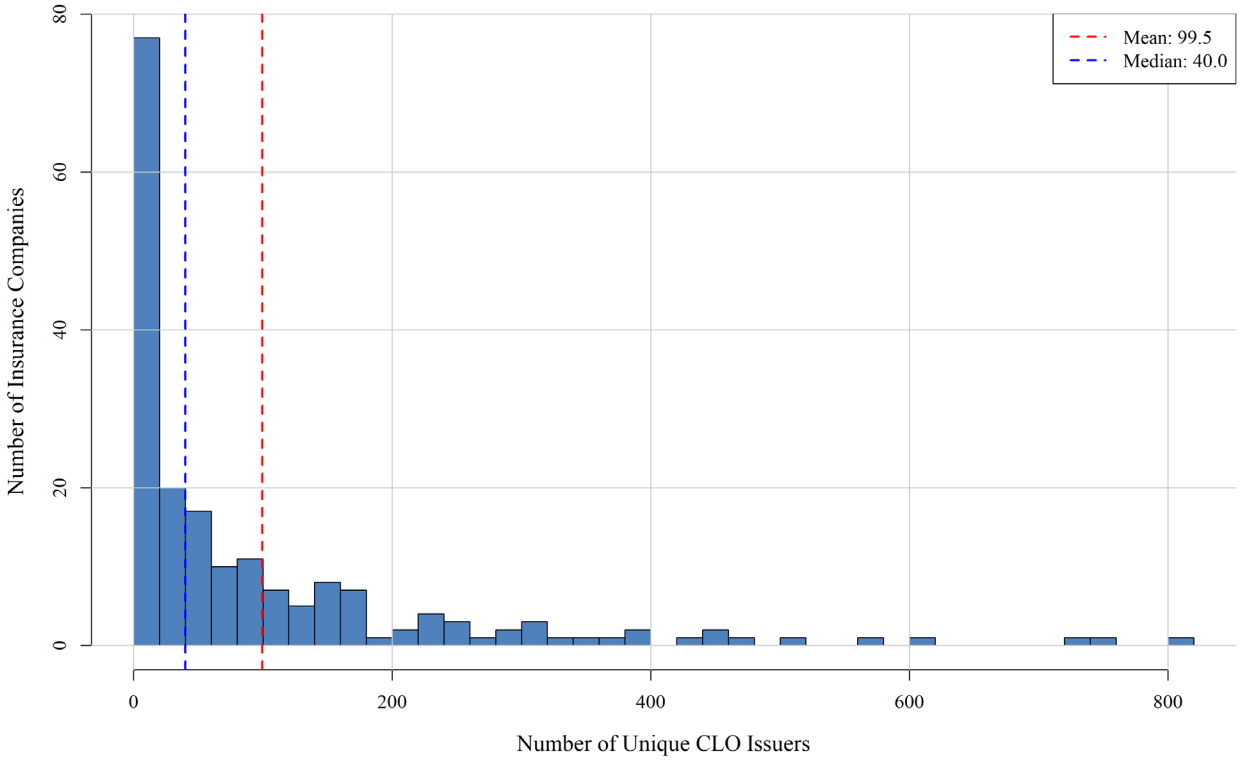


**Table 20 - Statistics on Number of Unique CLOs, Life Insurers (Group Level)**

| Statistic | Value |
|---|---|
| Total CLO Holdings | 27,947 |
| Unique CLO Deals | 3,310 |
| Median CLO holdings per co. | 51 |
| Median unique CLO deals per co. | 40 |
| Standard deviation | 145.9 |
| Range | 1 to 811 unique CLO deals |
| Q1 (25th percentile) | 7 unique CLO deals |
| Q3 (75th percentile) | 135 unique CLO deals |
| **Unique CLO Deals Count Range** | **# of Companies** |
| 1–10 | 56 |
| 11–25 | 23 |
| 26–50 | 29 |
| 51–100 | 27 |
| 101–200 | 28 |
| 201–500 | 24 |
| 501+ | 6 |

The Academy also looks at the size and credit quality of CLOs by number of CLOs owned. The purpose of C-1—in addition to being mathematically sound—is to identify real-world concerns of solvency. If the CLOs are small and/or high quality for those insurers with 10 or fewer, there is less immediate cause for concern.

In Figure 25 and Figure 26, the Academy observes two reassuring trends: 1) the proportion of CLO book value (to total *Schedule D1* book value) increases alongside deal diversification, and 2) the credit quality becomes riskier alongside deal diversification. In general, the companies with 10 or fewer—and especially those with 5 or fewer—CLOs have predominantly A3/above credit that is a small portion of bond allocation.

The notable exceptions are the two companies that own only one CLO with rating designations of NAIC 5 and 6. These two companies' CLOs represent less than 0.1% of total general account invested assets. Conversely, there are two companies that have ≤5 CLOs that make up almost 20% of *D1* assets and both of them allocate 100% to NAIC 1A. This data is provided for all life insurers in Appendix N.

With this context, the Academy believes that a PAF cutoff at owning 10 or fewer CLOs suffices and that the insurers owning more than 10 CLOs are sufficiently diversified that PAF is unnecessary.

**Figure 25 - Boxplot of CLO Book Value Ratio (to *Schedule D1* BV), by Number of Unique CLOs Owned**

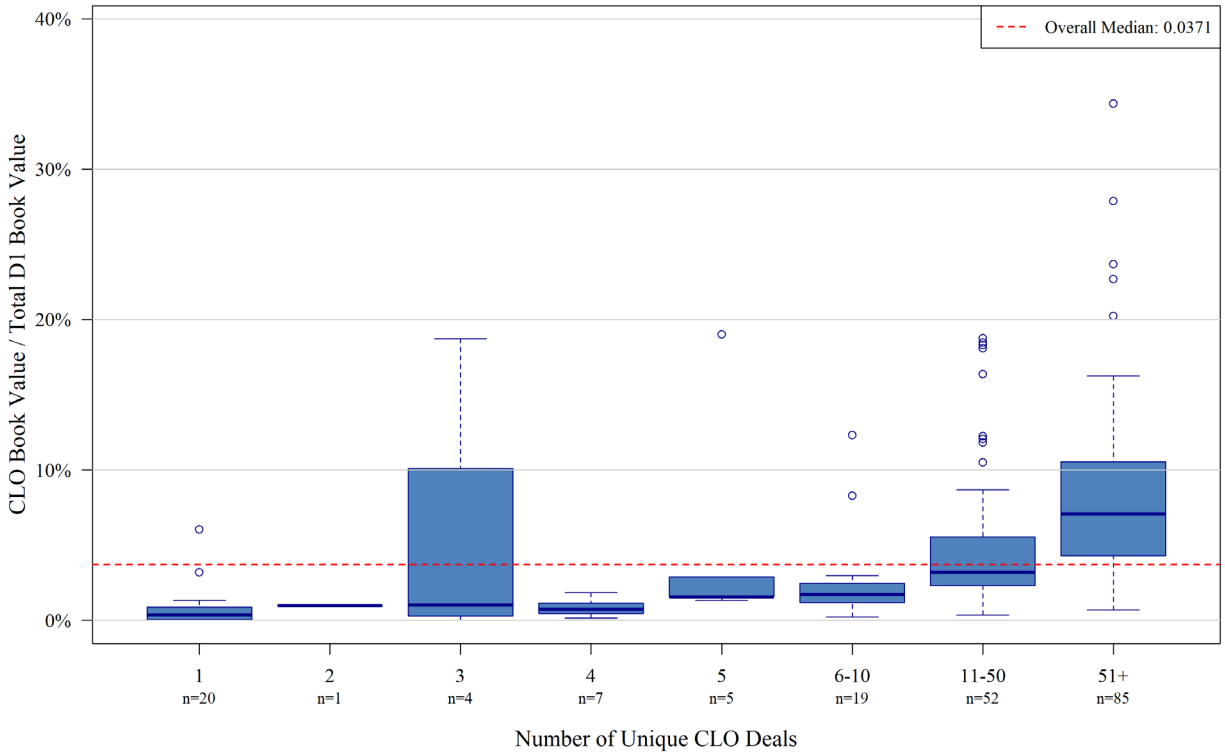
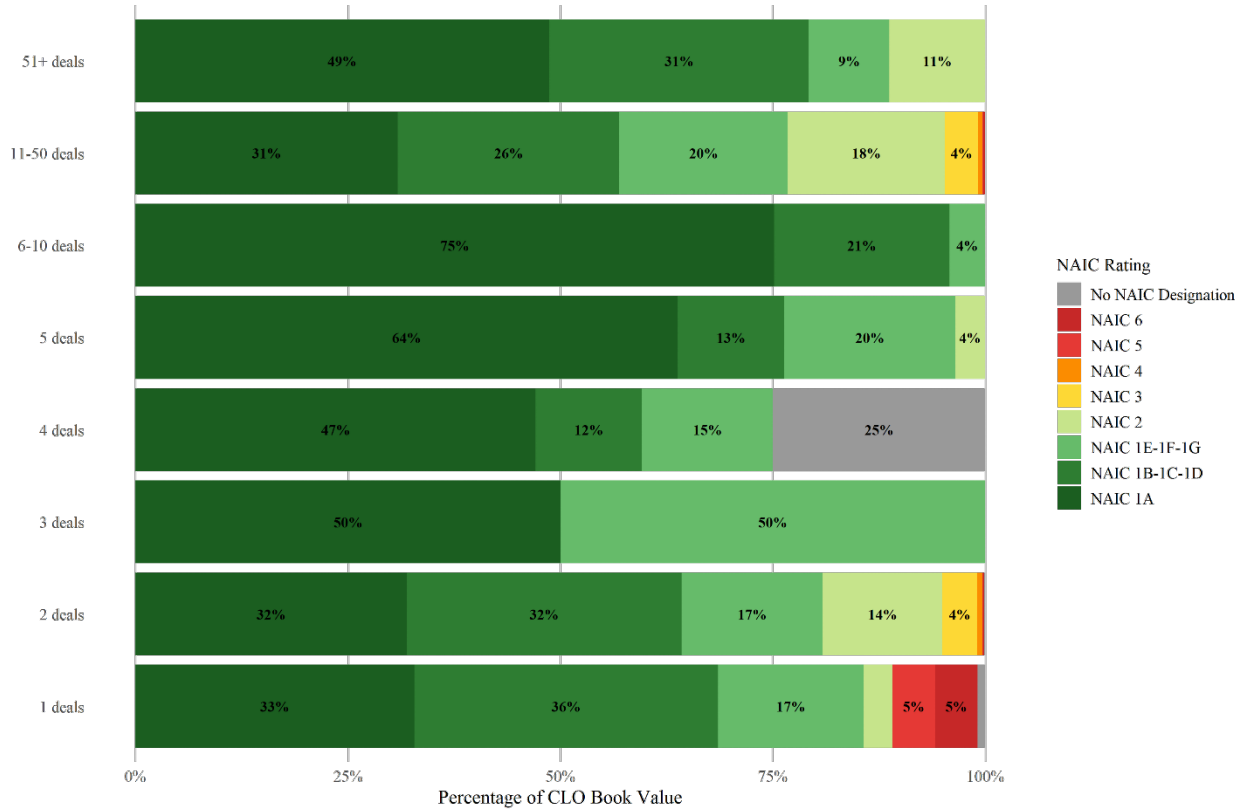



**Figure 26 - Distribution of CLO Credit Quality, by Number of CLOs Owned**



## 7.3 Proposed CLO PAF

The Academy proposes using the median relative PAF (by number of unique CLO deals owned) to avoid skew from small, seasoned CLOs. The Academy also proposes a factor of 1 for all insurers owning more than 10 unique CLO deals, due to the fast convergence of relative CLO PAF and the observed levels of diversification in the industry. Furthermore, the Academy recommends departing from the tiered bracket system used in the bond model; factors quickly change by number of CLOs owned and do not gradually decline like bond factors.

Proposed factors are:

**Table 21 - Proposed CLO Portfolio Adjustment Factors (PAFs) by Number of Unique CLOs Owned**

| # of Unique CLOs | **Proposed Portfolio Adjustment Factor** |
|---|---|
| 1 | **1.3907** |
| 2 | **1.2222** |
| 3 | **1.1586** |
| 4 | **1.1254** |
| 5 | **1.1060** |
| 6 | **1.0926** |
| 7 | **1.0831** |
| 8 | **1.0760** |
| 9 | **1.0704** |
| 10 | **1.0661** |
| 11+ | **1.0000** |

Alternatively, the Academy proposes a factor of 1.0 for all insurers, regardless of number of CLOs owned.

As detailed in Appendix N, more than half of insurers who hold 10 or fewer unique CLO deals are invested in Aa3 and above credit (specifically, 35 out of 56 insurers). For those insurers, implementation of the proposed PAFs would impact factors by *at most* 0.3907 × 0.04% = 0.015%. Among the insurers who invest in credit below Aa3, those who own three or fewer unique CLOs allocate no more than 0.9% of assets to CLOs. Those owning six or fewer allocate no more than 1.3% of total assets to CLOs. Those owning 7–10 CLOs allocate no more than 2.2% of total assets to CLOs, with the exception of one company that allocates 8.4% to CLOs.

The one outlier insurer owns three 2A CLOs, four thick 2C CLOs and two thin 2C CLOs. This averages out to a proposed base factor of 4.22%. The impact of PAF would be an increase of 0.0704 × 4.22% = 0.30%. In dollar amount, the PAF would increase the company's C-1o requirement by only 0.4% of total capital and surplus.

According to the first of the six guiding principles (see Section 3.1), "changes that have a small impact on RBC ratios may not justify a change to the RBC formula." For the vast majority of companies, the impact of the proposed PAF is either negligible or non-existent. For an outlier company, the impact is only 0.4% of capital and surplus. Given the relatively small impact of the proposal, the Academy concludes that the added complexity brought on by implementing PAF by number of issuers may not be justified.

# 8 Reconciliation of Proposed Model with Current C-1 Factors

The Academy performs an attribution analysis from the underlying loan losses to the weighted average C-1 Factors under the current and the proposed methodology. This section seeks to demonstrate that the

factors resulting from this model do not allow for RBC arbitrage[24].

## 8.1 Analyzing Collateral RBC, Collateral PV of Losses and Proposed CLO RBC

The Academy begins by comparing loans' current bond C-1 Factors (Collateral RBC shown below) to the modeled collateral present value of CTE90 losses (CLO Collateral Losses). For each CLO, the Academy looks through to the underlying loans and assigns a bond RBC by the loan rating. A weighted average is taken to get the RBC for the full portfolio of loans (by their balance within the CLO). Separately, the Academy looks at the 17 tail scenarios produced for CDOnet and assigns present value losses to all the underlying loans, utilizing the Riemann sum method to estimate CTE90 for the losses on those same loans.

Note that current bond factors are derived from VaR96 but the present value of collateral losses is CTE90. As shown in Appendix B, CTE90 is a roughly unbiased estimate of VaR96 in the bond model, so this discrepancy should not contribute much error.

In Figure 27, the difference between the collateral's RBC and CTE90 present value of losses is close to 0. The mean is 0.18% and median is -0.09%. This corroborates the Academy's implementation of the ACLI/MA Bond Model; there is no risk added or subtracted. For transparency, it should be noted that RBC includes losses on future reinvestments while the CTE90 PV losses apply only to original collateral. However, RBC also includes a risk premium that reduces the C-1 Factor below the present value of losses. These two discrepancies roughly offset one another.

**Figure 27 - Collateral Bond Model RBC minus PV Original Collateral Loss CTE90**

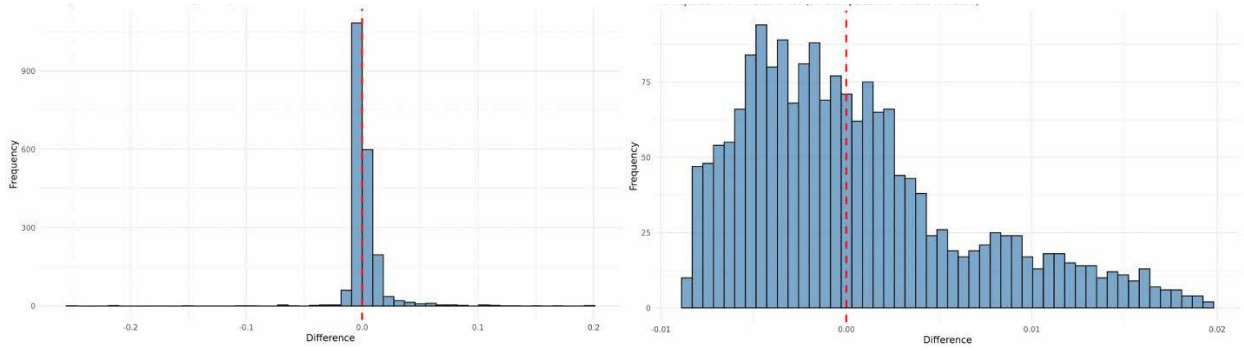
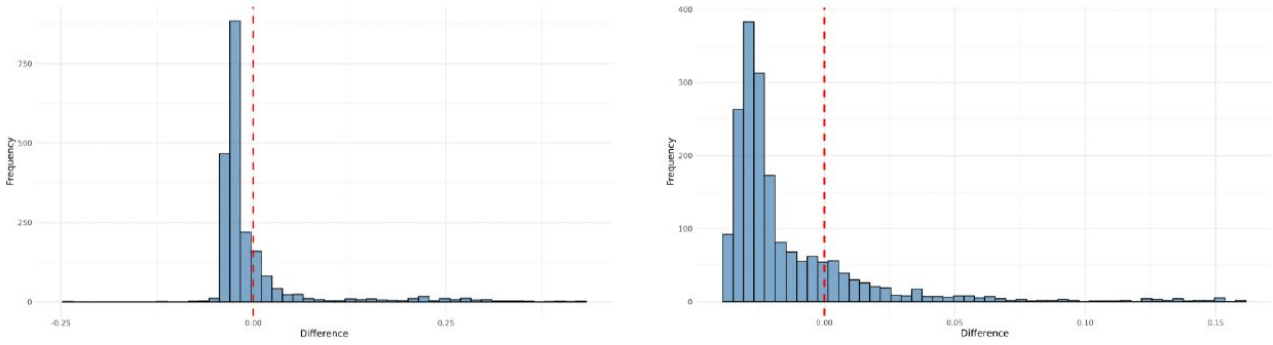



**Figure 28 - PV Original Collateral Loss CTE90 minus Proposed CLO RBC (Face Value-Weighted)**




The Academy concludes that there is no credit risk lost in the transition from bond factors to loan

[24] Here, RBC arbitrage is defined as a difference in capital required to hold a vertical slice of a CLO vs. holding its underlying collateral.

collateral losses. The Academy proceeds to evaluate the transition from collateral loss to proposed factors. For each CLO, the Academy applies the proposed factors to each tranche and averages the tranches together to estimate the CLO's vertical slice RBC.

In practice, CLO vertical slice RBC is derived by weighting the tranche RBC factors in proportion to *book value* since C-1 is calculated as a ratio of book value. But for this analysis, the Academy weights by *face value.* The reason for this is that the underlying loans are all assumed to be priced at par (both in the ACLI/MA Bond Model and in the Collateral Model), but CLO residual tranche accounting requires book value to dip below net asset value when income is received. This means that the total book value of the CLO vertical slice will almost always be less than the total book value of the underlying loans.

When the residual tranche's book value declines, the C-1 requirement for the security decreases in total dollar amount and the CLO's total RBC factor decreases. However, this decrease is not RBC arbitrage. If the residual tranche has less book value, it contributes less to TAC. This means that an insurance company owning the vertical slice CLO will report less asset value than an insurer owning all the underlying loans priced at par, despite owning an economically equivalent position.

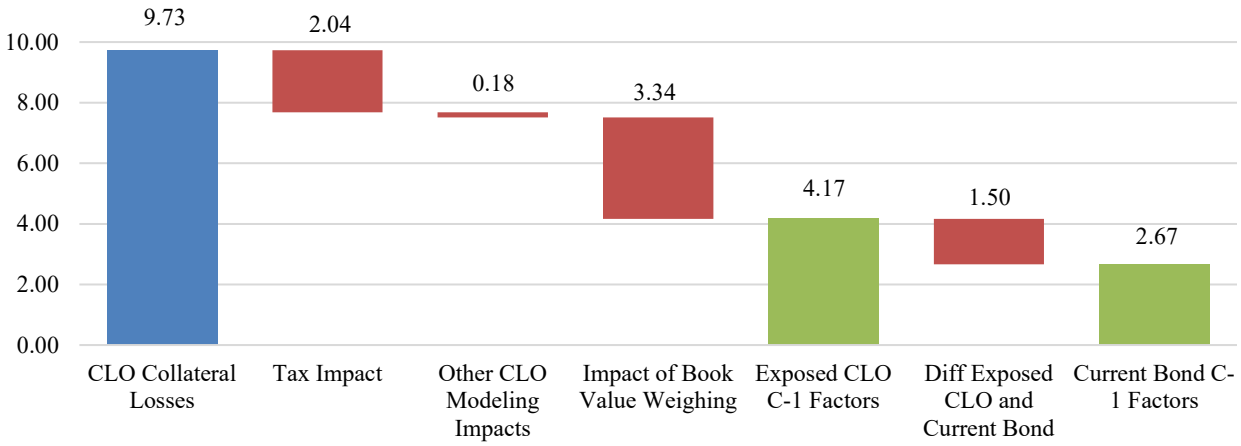
To make the calculations apples-to-apples, the Academy weights all the CLO tranches by face value in Figure 28 so that the CLO vertical slice has the same asset value as the underlying loans. The difference between the present value of original collateral losses at CTE90 and the vertical slice CLO RBC factors (also CTE90) averages -0.18% across all CLOs with a median of -2.44%. This indicates that *on average* the residual tranche accounting explains the gap between losses on collateral and final RBC factors. The skew in the median is further analyzed in Section 8.3.

## 8.2 Attribution Analysis from Collateral to Proposed CLO C-1 Factors

An attribution analysis is performed across the collateral and CLO deal universes, demonstrating that tax adjustments and residual tranche book value accounting explain the difference between the Final C-1 CLO Factors and the collateral losses modeled.

- CLO Collateral CTE90 Losses = PV of Pre-Tax Losses/Loan Balance as of 12/31/24 for CTE90 scenario
- Proposed CLO C-1 Factors on Vertical Slice = BV-weighted Proposed CLO C-1 Factors applied to the vertical slice of CLO deals based on the CLO tranche rating
- Current Bond C-1 Factors = BV-weighted Current C-1 Factors applied to the vertical slice of CLO deals based on the CLO tranche rating
- Tax Impact = CLO Collateral CTE90 Losses × 21%
- Impact of Book Value Weighting = Proposed CLO C-1 Factors – Face Value-Weighted Proposed C-1 Factors applied to the vertical slice of CLO deals based on the CLO tranche rating

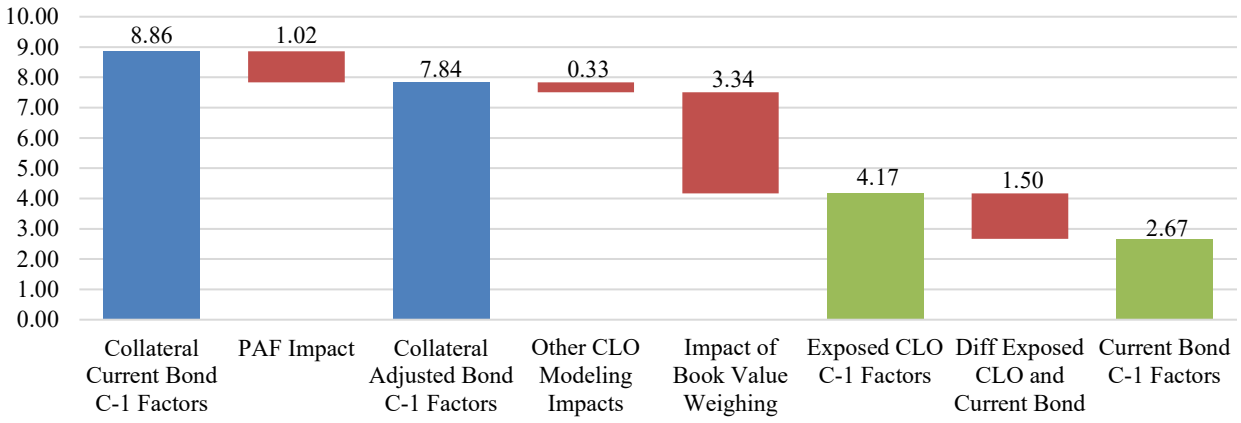
**Figure 29 - Collateral Losses vs. Proposed C-1 Factors Attribution Analysis**




The attribution analysis can be performed from the Current C-1 Factors applied to the collateral universe instead. The analysis demonstrates that diversification, represented by PAF, and residual tranche book value accounting explain the difference between the Final C-1 CLO Factors and the Current C-1 Factors.

- Collateral Base Current C-1 Factors = The base Current C-1 Bond Factors assigned by collateral issuer rating
- Collateral Adjusted Current C-1 Factors = Collateral Base Current C-1 Factors × PAF of 88.46%, estimated based on a total of 1,957 issuers in the collateral universe

**Figure 30 - Current C-1 of Collateral vs. Proposed C-1 of CLO Vertical Slice Attribution Analysis**




The Academy observes that the difference between the Current C-1 Factors, in particular the Bond Factors, and the Proposed CLO C-1 Factors is mostly explained by diversification (via PAF) and book value accounting of residual tranches. When comparing against the underlying collateral losses, the Proposed CLO C-1 Factors more accurately capture the risk at the CLO tranche level compared to the Current C-1 Factors.

## 8.3 Illustration of CLO with Median Collateral Loss

An example CLO deal is chosen because its collateral has the median loss PV across all deals. It is explored in detail, shown for the VaR96 loss scenario. As demonstrated in Appendix B, the VaR96 scenario is used as a proxy for CTE90. The Current Bond Factors are calibrated to VaR96.

**Table 22 - Detailed Attribution Analysis Calculation for Median Loss Example CLO Deal**

| Illustrative Numbers from VaR96 for Specific Deal at Median Loss | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Tranche Rating | DP (%) | Thickness (%) | FV ($mn) | BV ($mn) | Pre-Tax Loss Undisc. ($mn) | Post-Tax Loss PV ($mn) | Post-Tax Loss PV (% FV) | BV PV Loss ($mn) | Post-Tax BV PV Loss (% BV) |
| | | | A | B | C | D | D ÷ A | E | E ÷ B |
| Aaa | 100 | 63.8 | 410 | 410 | 0 | 0 | 0 | 0 | 0 |
| Aa2 | 36.2 | 12.2 | 78 | 78 | 0 | 0 | 0 | 0 | 0 |
| A2 | 24 | 7.1 | 46 | 46 | 0 | 0 | 0 | 0 | 0 |
| Baa3 | 17 | 6.1 | 39 | 39 | 0 | 0 | 0 | 0 | 0 |
| Ba3 | 10.9 | 3.8 | 24 | 24 | 22 | 14 | 56.87 | 14 | 56.87 |
| NR | 7.1 | 7.1 | 52 | 14 | 52 | 33 | 62.32 | 0 | 0 |
| **Total** | | | **649** | **610** | **74** | **46** | **7.13** | **14** | **2.23** |

In this example, the underlying collateral suffers $74mn of default (see column C). The face value of the residual tranche is $52mn and the face value of the Ba3 tranche is $24mn (i.e., $76mn total), so this loss fully penetrates the residual tranche and penetrates a majority of the Ba3 tranche. The losses do not occur until two years from the model date, so there are two years in which no impairment is recorded. The loss is lowered to $46mn when accounting for taxes and discounting. This accounts for 7.13% of the CLO's face value.

As illustrated in the prior section, CLO RBC factors are lowered by residual tranche accounting. In column B, it is shown that the residual tranche's starting book value is $14mn, which means $38mn of interest was received before Dec. 31, 2024, and used to pay down book value, under practical expedient accounting. In Section 8.2, it was demonstrated that the gap in initial face value and book value *on average* explains most of the gap between Bond RBC Factors (on the underlying collateral) and CLO Proposed Factors (on the vertical slices).

However, Figure 28 illustrated that this discrepancy only explains the gap on average; it does not explain the gap for the median CLO. If this CLO lost $14mn on the Ba3 tranche and $14mn on the residual tranche (the initial book value), the C-1 would be $28mn / $610mn = 4.59%. What is not considered is the interest paid to the residual tranche during the two years before impairment, for these exemplary cash flows. In that time, the residual tranche receives a hair over $14mn in interest which reduces the book value to $0. The final loss on the CLO is then $14mn and the loss as a proportion of book value is 2.23%.

In Table 23, it is shown that the collateral's average bond factor is 7.72% while the proposed CLO factor for the vertical slice is 2.34%, only 0.11% away from the VaR96 CLO book value loss. The gap is fully explained by the discrepancy in initial book/face value for the residual tranche *and* the change in book value from present to time of impairment.

**Table 23 - Attribution Analysis for Median Loss Example CLO Deal**

| Statistics for Specific Deal at Median Loss | |
|---|---|
| CLO Collateral CTE90 Loss PV (% of Face Value "FV" = Book Value "BV") | 7.47% |
| CLO Collateral Base Current C-1 Bond Factors (% of FV = BV) | 7.72% |
| CLO Vertical Slice Post-Tax VaR96 ***Face Value*** Loss PV (% of total FV) | 7.13% |
| CLO Vertical Slice Post-Tax VaR96 ***Book Value*** Loss PV (% of total BV) | 2.23% |
| Proposed CLO C-1 Factors on Vertical Slice | 2.34% |
| Current C-1 Factors on Vertical Slice | 1.31% |

Although the difference in residual book value accounting reduces the Proposed C-1 Factors for residual tranches, in the context of the overall U.S. RBC framework, TAC would have been reduced by the same book value accounting principles. The lower C-1 and lower TAC offset such that a life insurer that would reach its Company Action Level by holding the loans directly would also reach its Company Action Level by holding a CLO vertical slice.

**Table 24 - Residual Tranche BV / FV[25]**

| BV / FV | |
|---|---|
| Average | 35.02% |
| Standard Deviation | 30.63% |
| 10th Percentile | 0.00% |
| 25th Percentile | 2.37% |
| Median | 31.65% |
| 75th Percentile | 56.47% |
| 90th Percentile | 83.69% |

Here the Academy also offers an intuitive explanation through a stylized example, using only approximate numbers, alongside the precise empirical work shown above. A typical CLO contains a portfolio of loans that would require an approximately 8% weighted average C-1 if the loans were held directly by a life insurer. In other words, C-1 requires that the insurer demonstrate its ability to withstand an 8% reduction in book value. If an insurer instead owns a vertical slice of a CLO containing this same loan portfolio, the C-1 under the factors proposed herein would be only 4%. But residual tranche accounting will likely have caused the residual tranche to have reduced its book value by an amount equal to 4% of the total vertical slice: the residual tranche accounts for roughly 8% of CLO face value and close to half of the 8% is written off in book value. The C-1 of 4% plus the amount of book value already written off, also 4%, equals the same 8% C-1 requirement the insurer would have been required to hold had it owned the loans directly.

# 9 Limitations and Areas for Future Work

The CLO market has gone through a few significant restructurings. If CLO structures evolve significantly again, the C-1 Factors presented here might become stale.

Market evolution notwithstanding, the CLO C-1 Modeling Framework represents a significant methodological advancement in the regulatory capital of CLO investments held by life insurers. The model involves a number of simplifying assumptions, data constraints, and open methodological questions that the Academy acknowledges as limitations. This section synthesizes those limitations and identifies specific

[25] Face value equals net asset value.

areas where future research or refinement could improve the framework.

## 9.1 Scope and Data

### 9.1.1 Data and Ratings Coverage

The collateral file used to characterize CLO pools contains rating gaps that introduce uncertainty into the loan-level default rate assignments. Approximately 87.7% of collateral line items carry an issuer-level rating from either Moody's or S&P, and 95.1% carry at least one rating at the security or issuer level. The remaining unrated exposures require a rating assignment based on available proxies, and any misclassification at the loan level propagates into the scenario-level default vectors passed to CDOnet. Future iterations of the model would benefit from improved data sourcing to reduce unrated exposure counts.

Additionally, approximately 28.6% of line items with ratings from both Moody's and S&P carry disagreeing ratings across the two agencies, with the lower rating assigned as a conservative measure. A future enhancement would be to revise the approach to derive a single final rating when there are differing ratings across agencies.

### 9.1.2 Middle Market CLOs

The current model is calibrated exclusively to broadly syndicated loan (BSL) CLOs. Middle market CLOs—which are collateralized by loans to smaller, less liquid borrowers—are not included in the sample and are not explicitly addressed by the framework. Middle market loans typically exhibit different default and recovery characteristics than broadly syndicated loans, including higher concentration risk, lower secondary market liquidity and potentially different recovery dynamics. A separate model calibration for middle market CLOs, or an explicit adjustment to the BSL-derived factors, may be appropriate before extending the framework to that asset class.

## 9.2 Credit Loss Assumptions

### 9.2.1 Recovery Rate Methodology

Recovery rate assumptions differ systematically between S&P and Moody's methodologies. Moody's measures recovery using trading prices 30 days after default, while S&P measures ultimate recovery; the current model uses S&P ultimate recovery data because S&P provides a probability distribution in deciles, while Moody's only provides an average. The ACLI/MA Bond Model uses a distribution of recoveries by decile, so the S&P data allows for better alignment with the ACLI/MA Bond Model. However, trading prices would better represent the experience of CLOs, since CLOs typically sell defaulted loans prior to resolution. A future enhancement would be to develop a more formal reconciliation of the two agencies' recovery data sets and assess whether a blended or agency-specific approach better reflects the economic reality of CLO collateral.

### 9.2.2 Recovery Rate Assumptions

The current model uses S&P decile recovery data for senior secured and unsecured loans. Several limitations attach to this approach. First, the recovery data does not distinguish between junior secured loans and mezzanine instruments, which may experience materially different recovery outcomes than senior secured loans. A more granular segmentation of recovery distributions by seniority tier—including junior secured and unsecured categories—would improve the precision of loss modeling at the collateral level.

Second, secular trends in loan recovery rates driven by the widespread adoption of covenant-lite (cov-lite) loan structures are not explicitly modeled. Cov-lite agreements reduce lender protections and may compress recoveries in future default cycles relative to historical averages. The current model implicitly assumes the historical S&P recovery distribution is representative of future recoveries, which may be overly optimistic in a structurally weaker credit environment.

Third, recovery rates for senior and non-senior tranches of the same issuer are sampled independently in the simulation, which can produce the theoretically inconsistent outcome of a subordinated tranche recovering more than a senior tranche in a given scenario. This arises from the absence of a joint probability mass function governing the two recovery rates simultaneously. Should S&P (or Moody's) provide joint recovery distributions in the future, incorporating a correlated sampling approach would eliminate this inconsistency.

### 9.2.3 Default Rate Assumptions for Below-Investment-Grade Issuers

The default rates applied to Ba1/below-rated issuers in the Collateral Model are derived from the ACLI/MA Bond Model. There is an open question as to whether these rates are overly conservative when applied to leveraged loans, given the structural protections and active management embedded in CLO vehicles. The ACLI/MA Bond Model was designed to focus on IG public unsecured credit, while the collateral of CLOs is predominantly below-IG first-lien bank loans.

The low baseline IRRs for the residual tranche equity provide strong evidence that the default assumptions are overly punitive. Under the baseline run, the median IRR among new CLOs (no cash flows before Dec. 31, 2024) is 0%, indicating that the default rates may be unreasonable and not reflective of reality. Further investigation into loan-specific default rates for below-investment-grade issuers—distinct from bond-derived rates—could refine the Collateral Model and reduce potential conservatism at the lower end of the rating spectrum.

### 9.2.4 Modeling Correlation in Defaults

The Collateral Model applies a Gaussian copula with 10% pairwise default correlation, consistent with the ACLI/MA Bond Model, and this parameter is held constant for cross-model comparability. However, the Gaussian copula is a known limitation in structured credit modeling: it does not capture tail dependence, meaning it may understate the probability of simultaneous widespread defaults during systemic stress events. The Clayton copula sensitivity test demonstrated that alternative copula specifications can produce materially higher C-1 Factors for mezzanine and subordinated tranches, confirming that the copula choice is a consequential assumption. Alternative copula specifications should be reviewed when the ACLI/MA Bond Model assumptions and methodology are next modified.

### 9.2.5 Modeling Correlation in Recovery Rates

Similarly, the current Collateral Model does not capture correlation between recovery rates and default rates, nor the resulting correlation among recovery rates across issuers within the same scenario. In high-default environments, recoveries tend to be lower—both due to asset price depression and increased supply of distressed assets—meaning that treating recovery rates as independent of default severity understates tail losses. Sensitivity testing confirmed that introducing correlated severities produces notably higher C-1 Factors at mezzanine ratings. Incorporating a joint default-recovery correlation structure in future model iterations would improve the accuracy of tail loss estimation.

These limitations also apply to the ACLI/MA Bond Model. Should there be revisions to the bond model, it may be appropriate to revisit the correlation assumptions and stress test for transparency.

## 9.3 Reinvestment Assumptions and Methodology

### 9.3.1 Prepayment and Reinvestment Price Assumptions

The baseline assumptions in the CLO C-1 Modeling Framework assume no voluntary prepayment and reinvestment at par. Sensitivity analysis demonstrates that applying historically low prepayment speeds and discounted repurchase prices reduces C-1 Factors for certain tranches because prepayment activity under stress redistributes principal away from equity and toward rated tranches. Two sensitivities were tested. The first corresponds to the average of every observation less than or equal to the $10^{th}$ percentile of the historical data of each of the prepayment speeds and purchase prices. The second corresponds to the VaR0.5 of the

same data. The net directional impact of these assumptions is therefore tranche-dependent and non-trivial, and the current approach of maintaining both at baseline is acknowledged as an expedient rather than a fully optimized choice. A future enhancement would model prepayment rates and reinvestment prices specifically calibrated to high-default tail environments, providing a more internally consistent stress scenario rather than applying separate sensitivity tests.

### 9.3.2 Reinvestment Methodology

The reinvestment methodology used in the Collateral Model (Method 4) assigns default rates to reinvested loans based on average simulated loss rates starting at time zero, rather than accounting for the credit migration of those loans between the reinvestment date and the end of the stress horizon. This introduces a ratings mismatch: a loan reinvested one or more years into the scenario is assigned risk based on default rates 1+ years out from rating (rather than default rates for newly rated loans). A transition-matrix approach (Method 5) was considered but not implemented due to concerns about false precision and the introduction of additional model assumptions. Revisiting this approach or developing a simplified migration adjustment remains an area for future enhancement.

The reinvestment credit quality distribution (30% B1, 30% B2, 40% B3) and seniority mix (92.5% senior secured, 7.5% non-senior secured) are hard-coded as representative of the new-issue CLO market and are not adjusted at the deal level. While a review of the sample deals confirmed these parameters are broadly reasonable, soft-coding these inputs at the deal or vintage level would improve accuracy. Similarly, the reinvestment horizon of 2.5 years and the assumption that reinvested assets carry maturities exceeding 10 years are fixed assumptions that may not reflect the characteristics of individual deals, particularly seasoned CLOs with shortened reinvestment periods.

Lastly, a generic set of reinvestment assumptions is hard-coded across all CLO deals in the Collateral Model. A future refinement would be to reflect the individual deal's reinvestment parameters in the Collateral Model.

## 9.4 CLO Deal and C-1 Factor Assumptions

### 9.4.1 Risk Premium

The risk premium was assumed to be equal to the premium used for bonds of equal agency rating, from the ACLI/MA Bond Model. This assumption was made to maintain consistency with the ACLI/MA Bond Model; no additional research was done to evaluate what risk premium reasonably represents the risk covered by conservatism in the reserving assumptions.

Furthermore, the ACLI/MA Bond Model assumes that the risk premium sits half a standard deviation above mean for a given rating's present value. Since the Academy only has access to 17 scenarios that are processed by CDOnet, it was not possible to estimate mean and standard deviation. The 70$^{th}$ percentile roughly matches half a standard deviation over mean. Despite running a 70$^{th}$ percentile scenario, the Academy found the results to be too noisy to be useful. Should further analysis be done with more scenarios passed through CDOnet, it would be appropriate to add scenarios in the neighborhood of the 70$^{th}$ percentile to better estimate what the risk premium should be for CLOs.

### 9.4.2 CLO Resets and Refinancings

CLO resets and refinancings are not addressed in the current CLO C-1 Modeling Framework. A reset materially changes a CLO's structural characteristics—including its reinvestment period, liability costs, and collateral profile—and could substantially affect the applicable C-1 Factor. The current approach effectively treats all CLOs as static structures as of the modeling date. Future work should assess how resets and refinancings interact with the factor table and whether a post-reset recalibration or separate factor category is warranted.

### 9.4.3 Seasoning

The question of whether and how to capture the seasoning of individual CLO deals—that is, the degree to which a CLO's reinvestment period, collateral vintage, and structural features have evolved since issuance—was identified early in the C-1 Subcommittee's deliberations as a material modeling consideration. No specific CDOnet input or model parameter currently addresses seasoning in a systematic way. As the framework matures, developing an explicit treatment for deal seasoning would improve the granularity and accuracy of factor assignments across the CLO universe.

## 9.5 Modeling Methodology

### 9.5.1 Bucketing of A3-Rated Tranches

The treatment of A3-rated tranches in the comparable attributes regression model is an open methodological question. A3 presents a persistent fitting challenge due to its compressed reinvestment horizon, limited data observations, and position at the boundary between two natural groupings. The tranche can plausibly be grouped with A2 (for statistical credibility) or with Baa1 (for structural similarity within the reinvestment interaction term). The two bucketing approaches tested (labeled "Proposed Buckets" and "Alternative Buckets") do not produce a decisive outcome, so simple averaging the two factors together was a subjective determination. Future refinement, particularly as additional data becomes available, should revisit these bucketing options with a larger sample.

### 9.5.2 Scenario Count

The CTE90 calculation is based on 17 tail scenarios drawn from 10,000 simulated scenarios generated by the Collateral Model. While 17 scenarios are sufficient to define CTE90 at a point estimate, a larger number of scenarios spanning the tail would reduce Monte Carlo estimation error and produce more stable factor estimates, particularly for tranches near the boundary of the stressed tail. Computational constraints limited the current implementation, and expanding the scenario count in future iterations would improve precision.

### 9.5.3 Isotonic Regression

A corollary model limitation is the use of isotonic regression. The regression does not help explain variation; it is a post hoc modeling decision that smooths out unintuitive results. Because there are so few non-zero C-1 Factors for A/above CLOs, the charges are subject to sampling error. If more stochastic simulations were run, it is possible that the average factors for A/above CLOs would monotonically increase as rating declines. There is no way to verify this due to the limited sample size and limited number of simulations.

### 9.5.4 Tranche Thickness Groupings

The Academy determined tranche thickness to be an important comparable attribute, but, for simplicity, created a binary flag for thickness greater than or less than 4%. Further subdivisions of thickness were not tested since the 4% cutoff appears sufficient for the data set analyzed. It is not necessarily the case that 4% would be an effective cutoff line in future iterations of this model, particularly should the market evolve and the typical CLO structures change.

Additionally, the 4% number was chosen heuristically rather than computationally. 4% was selected based on how it bifurcates Baa3 tranches but with little regard to lower-rated tranches that are less widely held by life insurers. This avoids false precision, but a different cutoff (like 4.25%) may better differentiate groups of risks. The Academy leaves this as an open debate, given that there are operational barriers to implementation. Adding tranche thickness as a comparable attribute in the RBC formula would require an amendment to the RBC templates.

### 9.5.5 Interaction Term Buckets

When regressing C-1 against reinvestment horizon, interaction terms are integral due to the non-linear increase of C-1 across ratings. However, as discussed, credibility issues preclude the Academy from regressing against a unique coefficient on reinvestment horizon for each rating. Doing so produces erratic results. To solve this, similar ratings must be bucketed together for the purpose of estimating the effect of reinvestment horizon on C-1. For most ratings, the choice of buckets does not materially impact the derived factors. But for A3, the factor radically changes when it is grouped with Baa1/Baa2 rather than A1/A2. There is no objective test to determine which grouping is "right." Accordingly, the Academy made a judgment call on this factor based on the data available. Should more A3 tranches exist in the future, this specific rating should be the subject of additional research.

### 9.5.6 Allowable Earned Yield C-1 Modeling

The IRRs used to estimate book yield introduce survivorship bias by implicitly assuming that the insurer rightly predicted the past interest payments. However, the survivorship bias slightly counteracts the even greater issue: the baseline projections produce residual tranche IRRs near 0%, particularly when focusing on newly issued securities. This issue causes the allowable earned yield C-1 Factors to closely approximate practical expedient factors. It prevents the Academy from doing a comprehensive analysis on how accounting method impacts risk (and whether the two accounting methods should have different C-1 Factors) and it prevents the Academy from evaluating the impact of assuming that residual tranches are only surplus-backing (the liability-backing accounting also approaches practical expedient accounting when book yield approaches 0%). To conduct such an analysis, the overall model would first have to be altered to remove its inherent conservatism. Specifically, residual tranche IRRs would need to be significantly higher than zero.

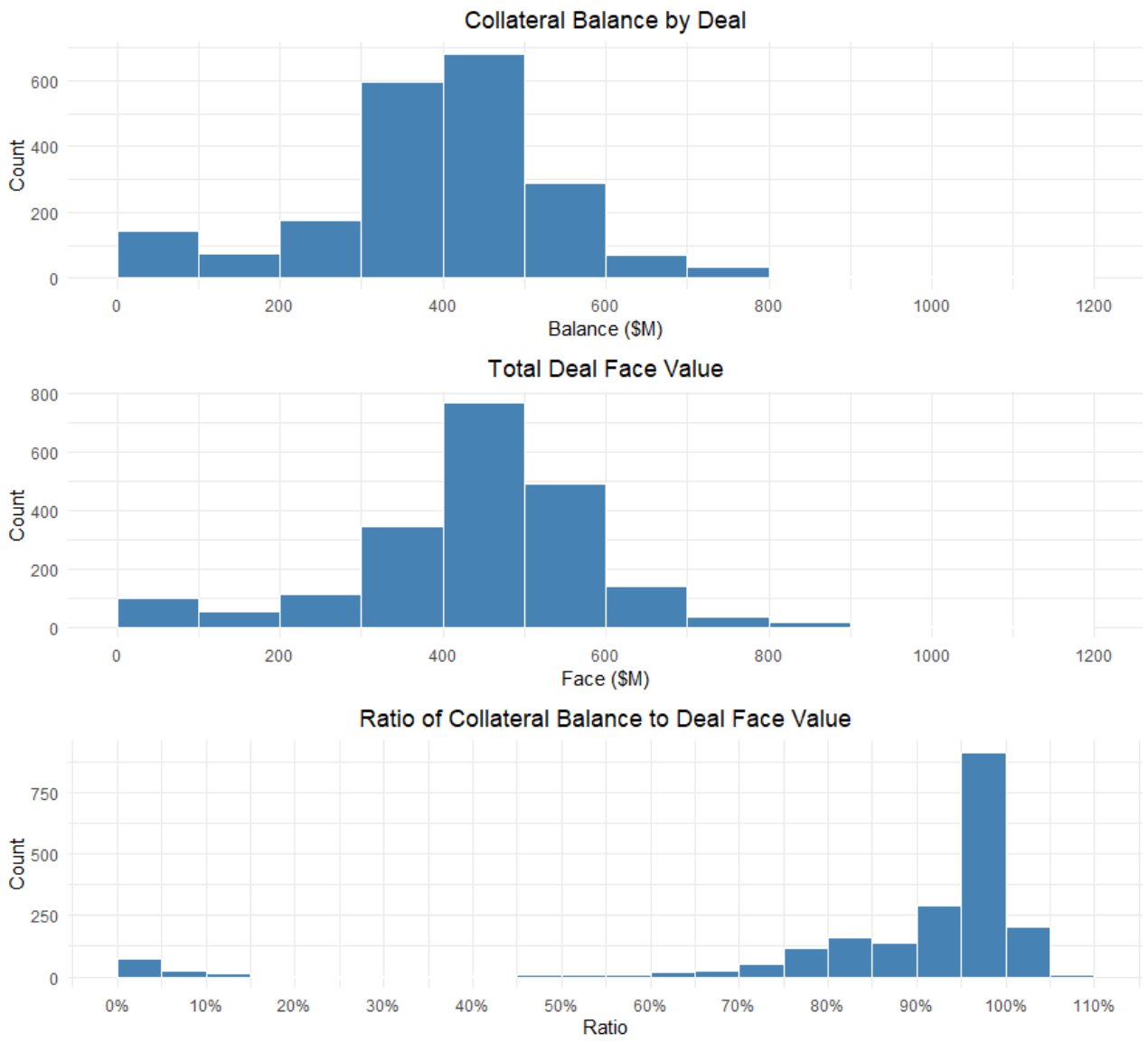
### 9.5.7 Residual Tranche Comparable Attributes

The Academy failed to identify sufficiently explanatory residual tranche comparable attributes. Certain variables, like debt credit quality, did have statistically significant predictive power, but the explanatory power was dwarfed by random noise in the C-1 Factors. It is unclear if the random noise is endemic to the product or if the noise is caused by model error and compounded in the residual tranche. The large dispersion within each tested risk bucket may also be driven by residual tranche accounting, where the book value relative to face value is sufficiently important to overpower other variables that more directly represent investment risk rather than statutory book value risk.

Future analysis would likely require more than 17 cash flow simulations to overcome the sampling noise. The analysis would also be improved if each CLO were modeled from issuance. The CLOs passed through CDOnet include those that began payments multiple years prior to the simulation start date. In such cases, the book value can be reduced down to (or close to) 0, which reduces the number of effective data points. Were the CLOs all modeled from issuance and C-1 Factors calculated by year, the residual tranche C-1 Factors could be regressed against the time-since-issuance to better isolate the intrinsic risk of the securities.

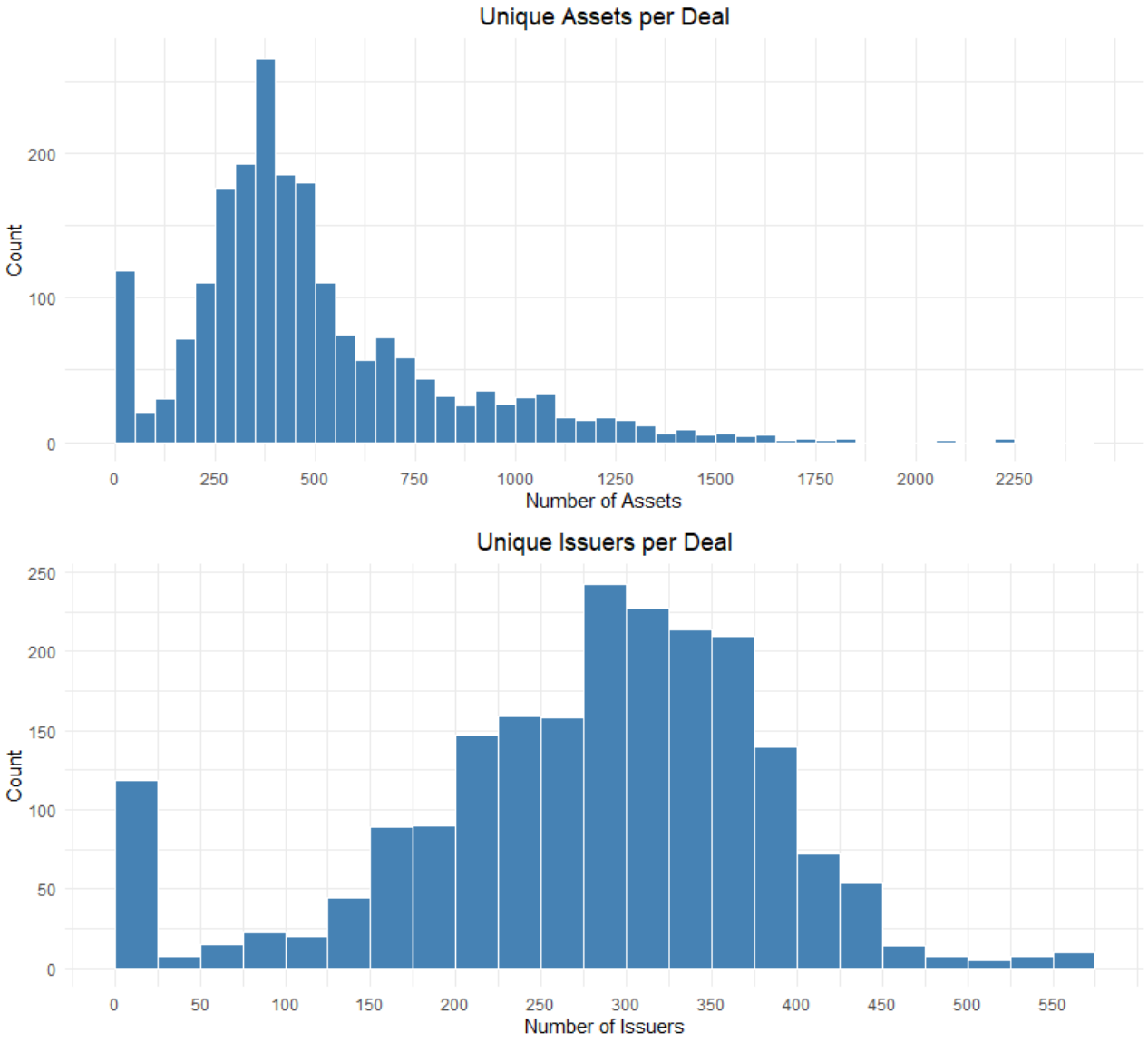
# Appendix A Data Input Summary

**Figure A.1 - Distribution of Collateral Balance**

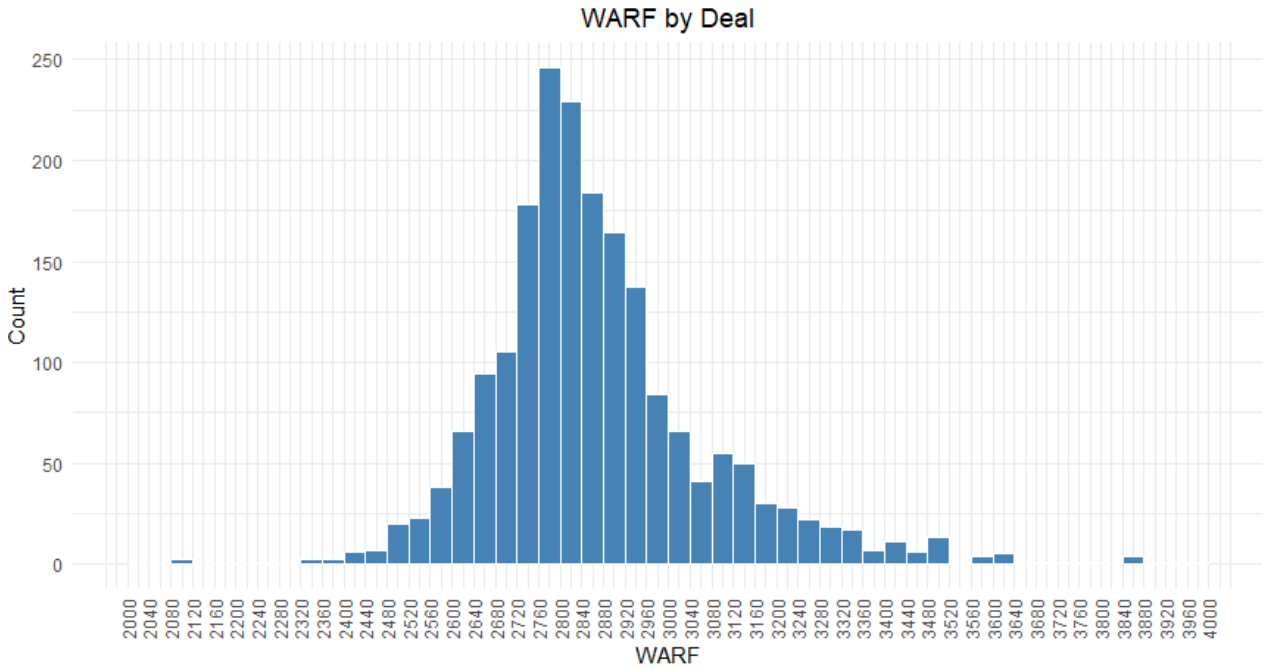



| | | | Percentiles | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | **Mean** | **Std** | **1%** | **5%** | **10%** | **25%** | **50%** | **75%** | **90%** | **95%** | **99%** |
| **Collateral Balance by Deal ($mn)** | **419.0** | 135.7 | 4.3 | 182.9 | 253.9 | 374.2 | **404.7** | 495.8 | 561.5 | 604.3 | 786.6 |
| **Total Deal Face Value ($mn)** | **452.7** | 129.9 | 107.6 | 252.8 | 313.2 | 400.2 | **434.1** | 508.7 | 604.9 | 651.1 | 834.1 |
| **Ratio (Collateral to Deal)** | **90.9%** | 15.0% | 3.9% | 68.9% | 77.7% | 88.1% | **96.0%** | 98.5% | 100.1% | 101.4% | 104.0% |

**Figure A.2 - Distribution of Unique Loans per CLO Deal**



## Figure A.3 - Distribution of WARF by CLO Deal




| | | | Percentiles | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | **Mean** | Std | 1% | 5% | 10% | 25% | **50%** | 75% | 90% | 95% | 99% |
| **WARF by Deal** | **3,019** | 745 | 2,483 | 2,600 | 2,660 | 2,755 | **2,844** | 2,979 | 3,254 | 3,948 | 7,003 |

## Table A.1 - Missing Ratings in Collateral Data

| | | | Percentiles | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | **Mean** | Std | 1% | 5% | 10% | 25% | **50%** | 75% | 90% | 95% | 99% |
| **Unique Assets (total count)** | **515** | 312 | 9 | 174 | 235 | 318 | **422** | 631 | 977 | 1,175 | 1,532 |
| **Unique Issuers (total count)** | **290** | 93 | 5 | 132 | 171 | 233 | **299** | 355 | 394 | 425 | 510 |

| | By Frequency | | By Balance | |
|---|---|---|---|---|
| | Count | Proportion | Aggregate | Proportion |
| Moody's Issuer | 268,273 | 21.5% | 301,718,147,896 | 25.7% |
| S&P Issuer | 222,727 | 17.9% | 292,151,917,814 | 24.9% |
| Moody's Security | 59,530 | 4.8% | 111,744,952,079 | 9.5% |
| S&P Security | 73,582 | 5.9% | 129,844,442,522 | 11.0% |
| Fitch Security | 632,984 | 50.8% | 609,538,948,843 | 51.9% |
| Both Issuer Ratings | 93,425 | 7.5% | 144,059,707,568 | 12.3% |
| All 3 Security Ratings | 28,732 | 2.3% | 59,598,769,290 | 5.1% |
| All 5 Rating | 27,624 | 2.2% | 57,882,274,954 | 4.9% |

# Appendix B Stress Testing ACLI/MA Bond Model Parameters

## CTE vs. VaR

The Academy adjusts the R script provided by Moody's Analytics so that base C-1 is estimated from conditional tail expectation (rather than value-at-risk). Comparing the published VaR96 to various CTEs (below), the Academy finds that CTE90 is the most neutral alternative.

**Table B.1 - Estimated CTE and VaR96 from ACLI/MA Bond Model**

| | VaR | CTE | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 96 | 86 | 87 | 88 | 89 | 90 | 91 | 92 | 93 | 94 | 95 | 96 |
| Aaa | 0.16% | 0.14% | 0.15% | 0.15% | 0.16% | 0.17% | 0.18% | 0.20% | 0.21% | 0.23% | 0.25% | 0.27% |
| Aa1 | 0.27% | 0.23% | 0.24% | 0.26% | 0.27% | 0.28% | 0.30% | 0.31% | 0.33% | 0.36% | 0.38% | 0.42% |
| Aa2 | 0.42% | 0.38% | 0.39% | 0.41% | 0.43% | 0.44% | 0.46% | 0.49% | 0.51% | 0.54% | 0.58% | 0.62% |
| Aa3 | 0.52% | 0.48% | 0.50% | 0.52% | 0.54% | 0.57% | 0.59% | 0.62% | 0.65% | 0.69% | 0.73% | 0.79% |
| A1 | 0.66% | 0.60% | 0.62% | 0.64% | 0.67% | 0.69% | 0.72% | 0.76% | 0.80% | 0.84% | 0.89% | 0.95% |
| A2 | 0.82% | 0.72% | 0.75% | 0.78% | 0.81% | 0.84% | 0.88% | 0.92% | 0.96% | 1.02% | 1.08% | 1.16% |
| A3 | 1.02% | 0.90% | 0.93% | 0.97% | 1.01% | 1.05% | 1.09% | 1.14% | 1.20% | 1.26% | 1.34% | 1.43% |
| Baa1 | 1.26% | 1.11% | 1.15% | 1.19% | 1.23% | 1.28% | 1.34% | 1.40% | 1.48% | 1.56% | 1.66% | 1.79% |
| Baa2 | 1.52% | 1.37% | 1.41% | 1.46% | 1.51% | 1.57% | 1.63% | 1.69% | 1.77% | 1.85% | 1.95% | 2.07% |
| Baa3 | 2.17% | 1.95% | 2.02% | 2.09% | 2.16% | 2.24% | 2.33% | 2.43% | 2.55% | 2.68% | 2.83% | 3.02% |
| Ba1 | 3.15% | 2.84% | 2.93% | 3.03% | 3.13% | 3.25% | 3.37% | 3.51% | 3.66% | 3.84% | 4.05% | 4.31% |
| Ba2 | 4.54% | 4.18% | 4.30% | 4.43% | 4.56% | 4.71% | 4.87% | 5.05% | 5.26% | 5.49% | 5.76% | 6.10% |
| Ba3 | 6.02% | 5.25% | 5.40% | 5.56% | 5.73% | 5.91% | 6.12% | 6.35% | 6.61% | 6.91% | 7.27% | 7.71% |
| B1 | 7.39% | 6.63% | 6.80% | 6.99% | 7.19% | 7.40% | 7.64% | 7.90% | 8.18% | 8.51% | 8.89% | 9.36% |
| B2 | 9.54% | 8.54% | 8.75% | 8.98% | 9.22% | 9.48% | 9.78% | 10.09% | 10.45% | 10.86% | 11.34% | 11.93% |
| B3 | 12.43% | 11.27% | 11.52% | 11.79% | 12.08% | 12.39% | 12.74% | 13.12% | 13.56% | 14.08% | 14.67% | 15.38% |
| Caa1 | 16.94% | 15.35% | 15.63% | 15.94% | 16.27% | 16.62% | 17.01% | 17.45% | 17.93% | 18.48% | 19.11% | 19.90% |
| Caa2 | 23.80% | 22.18% | 22.55% | 22.95% | 23.38% | 23.84% | 24.35% | 24.89% | 25.50% | 26.20% | 27.01% | 28.02% |
| Caa3 | 32.98% | 31.07% | 31.49% | 31.94% | 32.41% | 32.92% | 33.49% | 34.12% | 34.80% | 35.57% | 36.44% | 37.47% |

**Table B.2 - Estimated CTE vs. VaR96 from ACLI/MA Bond Model**

| | CTE – VaR96 | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | 86 | 87 | 88 | 89 | 90 | 91 | 92 | 93 | 94 | 95 | 96 |
| Aaa | -0.02% | -0.01% | 0.00% | 0.00% | 0.01% | 0.03% | 0.04% | 0.05% | 0.07% | 0.09% | 0.12% |
| Aa1 | -0.04% | -0.03% | -0.02% | 0.00% | 0.01% | 0.03% | 0.04% | 0.06% | 0.09% | 0.11% | 0.15% |
| Aa2 | -0.04% | -0.02% | -0.01% | 0.01% | 0.03% | 0.05% | 0.07% | 0.09% | 0.12% | 0.16% | 0.21% |
| Aa3 | -0.04% | -0.02% | 0.00% | 0.02% | 0.04% | 0.07% | 0.10% | 0.13% | 0.17% | 0.21% | 0.26% |
| A1 | -0.06% | -0.04% | -0.02% | 0.01% | 0.04% | 0.07% | 0.10% | 0.14% | 0.18% | 0.24% | 0.30% |
| A2 | -0.09% | -0.07% | -0.04% | -0.01% | 0.03% | 0.06% | 0.10% | 0.15% | 0.20% | 0.27% | 0.35% |
| A3 | -0.11% | -0.08% | -0.05% | -0.01% | 0.03% | 0.07% | 0.13% | 0.18% | 0.25% | 0.32% | 0.42% |
| Baa1 | -0.15% | -0.11% | -0.07% | -0.03% | 0.02% | 0.08% | 0.14% | 0.21% | 0.30% | 0.40% | 0.53% |
| Baa2 | -0.16% | -0.11% | -0.06% | -0.01% | 0.04% | 0.10% | 0.17% | 0.25% | 0.33% | 0.43% | 0.55% |
| Baa3 | -0.21% | -0.15% | -0.08% | -0.01% | 0.08% | 0.16% | 0.27% | 0.38% | 0.51% | 0.66% | 0.85% |
| Ba1 | -0.31% | -0.22% | -0.12% | -0.02% | 0.10% | 0.22% | 0.36% | 0.51% | 0.69% | 0.90% | 1.16% |
| Ba2 | -0.36% | -0.24% | -0.11% | 0.03% | 0.17% | 0.34% | 0.52% | 0.72% | 0.95% | 1.22% | 1.56% |
| Ba3 | -0.77% | -0.62% | -0.46% | -0.29% | -0.10% | 0.10% | 0.33% | 0.59% | 0.89% | 1.25% | 1.70% |
| B1 | -0.76% | -0.58% | -0.40% | -0.20% | 0.02% | 0.25% | 0.51% | 0.79% | 1.12% | 1.51% | 1.98% |
| B2 | -0.99% | -0.78% | -0.56% | -0.32% | -0.05% | 0.24% | 0.56% | 0.92% | 1.32% | 1.80% | 2.39% |
| B3 | -1.16% | -0.91% | -0.64% | -0.35% | -0.03% | 0.31% | 0.70% | 1.14% | 1.65% | 2.24% | 2.95% |
| Caa1 | -1.60% | -1.31% | -1.00% | -0.67% | -0.32% | 0.07% | 0.51% | 0.99% | 1.53% | 2.17% | 2.96% |
| Caa2 | -1.62% | -1.25% | -0.85% | -0.42% | 0.04% | 0.55% | 1.09% | 1.70% | 2.40% | 3.22% | 4.22% |
| Caa3 | -1.91% | -1.48% | -1.04% | -0.56% | -0.05% | 0.52% | 1.14% | 1.83% | 2.60% | 3.46% | 4.49% |
| RMSE | 0.82% | 0.64% | 0.45% | 0.26% | 0.10% | 0.23% | 0.49% | 0.78% | 1.11% | 1.50% | 1.97% |

## Including/Excluding Economic States

When re-running the R script provided by Moody's Analytics *without* the economic states (i.e., assuming the economic state is always expanding), the resulting C-1 Factors are on average roughly unchanged.

**Table B.3 - Economic States Stress Test from ACLI/MA Bond Model**

| | With Econ States | Without Econ States | Difference |
|---|---|---|---|
| Aaa | 0.16% | 0.16% | 0.00% |
| Aa1 | 0.27% | 0.26% | -0.01% |
| Aa2 | 0.42% | 0.43% | 0.01% |
| Aa3 | 0.52% | 0.55% | 0.02% |
| A1 | 0.66% | 0.68% | 0.02% |
| A2 | 0.82% | 0.80% | -0.02% |
| A3 | 1.02% | 1.00% | -0.01% |
| Baa1 | 1.26% | 1.22% | -0.04% |
| Baa2 | 1.52% | 1.53% | 0.01% |
| Baa3 | 2.17% | 2.19% | 0.02% |
| Ba1 | 3.15% | 3.16% | 0.01% |
| Ba2 | 4.54% | 4.68% | 0.14% |
| Ba3 | 6.02% | 5.73% | -0.29% |
| B1 | 7.39% | 7.32% | -0.07% |
| B2 | 9.54% | 9.40% | -0.14% |
| B3 | 12.43% | 12.23% | -0.19% |
| Caa1 | 16.94% | 16.38% | -0.56% |
| Caa2 | 23.80% | 23.58% | -0.22% |
| Caa3 | 32.98% | 32.90% | -0.08% |

## Comparing Gaussian Copula Correlations

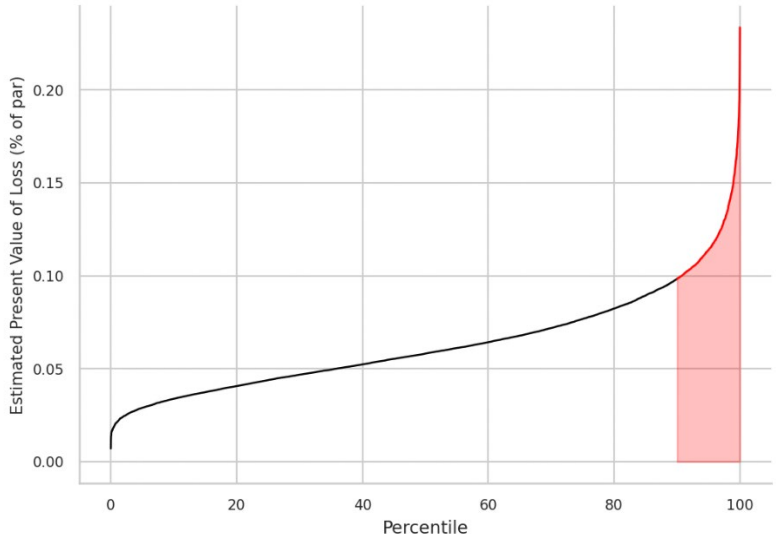
The ACLI/MA Bond Model assumes 10% correlation in the Gaussian copula. Re-running the code provided by Moody's Analytics with alternate correlation assumptions yields a wide range of C-1 Factors.

**Table B.4 - Correlation Stress Test from ACLI/MA Bond Model**

| | Adopted | Gaussian-Copula Correlation: | | | | Difference | | | |
|---|---|---|---|---|---|---|---|---|---|
| | C-1 Factors | 0% | 5% | 20% | 40% | 0% | 5% | 20% | 40% |
| Aaa | 0.16% | 0.15% | 0.15% | 0.16% | 0.18% | -0.01% | -0.01% | 0.00% | 0.02% |
| Aa1 | 0.27% | 0.24% | 0.26% | 0.31% | 0.37% | -0.03% | -0.01% | 0.04% | 0.10% |
| Aa2 | 0.42% | 0.37% | 0.41% | 0.54% | 0.81% | -0.05% | -0.01% | 0.12% | 0.39% |
| Aa3 | 0.52% | 0.42% | 0.48% | 0.69% | 0.98% | -0.10% | -0.04% | 0.16% | 0.46% |
| A1 | 0.66% | 0.50% | 0.59% | 0.90% | 1.52% | -0.16% | -0.07% | 0.24% | 0.86% |
| A2 | 0.82% | 0.58% | 0.68% | 1.15% | 2.16% | -0.23% | -0.13% | 0.33% | 1.35% |
| A3 | 1.02% | 0.66% | 0.80% | 1.50% | 2.64% | -0.36% | -0.22% | 0.49% | 1.62% |
| Baa1 | 1.26% | 0.75% | 0.96% | 1.86% | 3.35% | -0.51% | -0.30% | 0.60% | 2.09% |
| Baa2 | 1.52% | 0.88% | 1.19% | 2.40% | 4.32% | -0.65% | -0.33% | 0.88% | 2.80% |
| Baa3 | 2.17% | 1.10% | 1.60% | 3.47% | 6.11% | -1.07% | -0.57% | 1.30% | 3.94% |
| Ba1 | 3.15% | 1.41% | 2.24% | 4.96% | 9.32% | -1.74% | -0.91% | 1.81% | 6.17% |
| Ba2 | 4.54% | 1.86% | 3.33% | 7.39% | 13.09% | -2.67% | -1.20% | 2.86% | 8.56% |
| Ba3 | 6.02% | 2.21% | 4.10% | 8.81% | 15.59% | -3.81% | -1.91% | 2.79% | 9.58% |
| B1 | 7.39% | 2.78% | 5.32% | 11.23% | 18.99% | -4.61% | -2.07% | 3.84% | 11.60% |
| B2 | 9.54% | 3.47% | 6.94% | 14.19% | 23.55% | -6.06% | -2.60% | 4.65% | 14.01% |
| B3 | 12.43% | 5.00% | 9.05% | 17.50% | 28.04% | -7.43% | -3.38% | 5.07% | 15.62% |
| Caa1 | 16.94% | 7.56% | 13.04% | 23.50% | 34.82% | -9.38% | -3.91% | 6.55% | 17.88% |
| Caa2 | 23.80% | 11.86% | 18.95% | 30.62% | 43.70% | -11.94% | -4.85% | 6.82% | 19.90% |
| Caa3 | 32.98% | 18.80% | 27.46% | 42.33% | 55.81% | -14.18% | -5.51% | 9.36% | 22.84% |

# Appendix C Scenario Weights

**Figure C.1 - Illustrative CTE90**

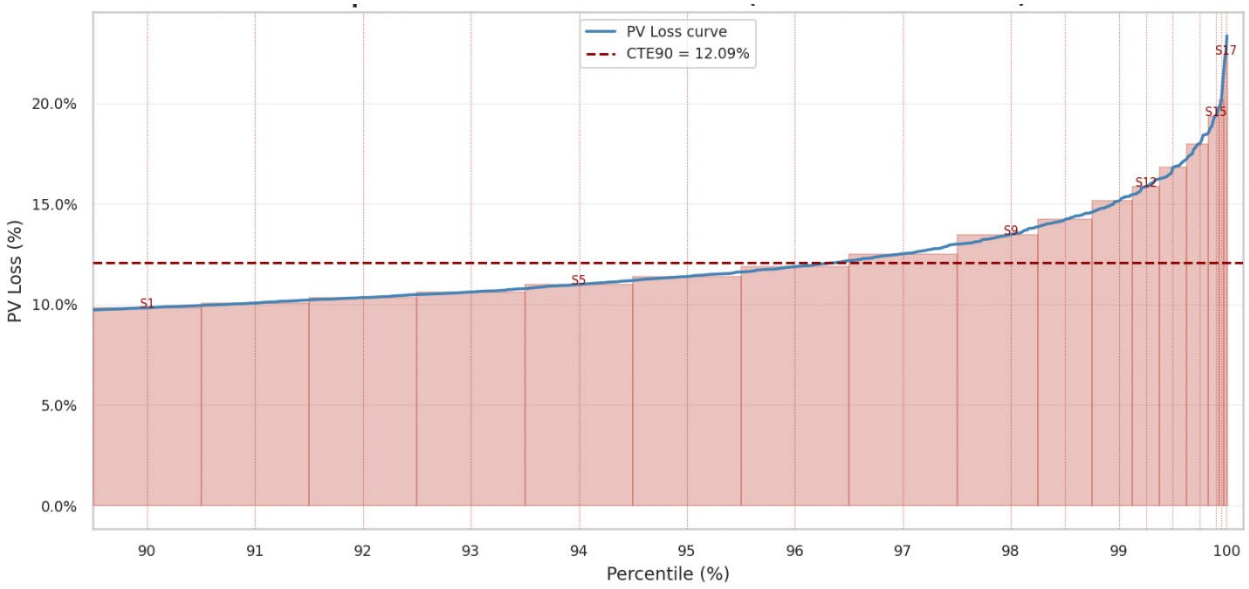



The Academy models 18 scenarios. The 70$^{th}$ percentile is run as a reference for researching risk premium; the other 17 are run to model the tail risk. Because the tail losses increase at an increasing rate, the percentiles become more granular the farther right they get. The Midpoint Riemann Sum method is used to approximate the CTE. The weights are as follows:

### Table C.1 - Percentile Scenario Weights for CTE90

| Scenario # | Percentile | Weight |
|---|---|---|
| 1 | 90.00 | 5.00% |
| 2 | 91.00 | 10.00% |
| 3 | 92.00 | 10.00% |
| 4 | 93.00 | 10.00% |
| 5 | 94.00 | 10.00% |
| 6 | 95.00 | 10.00% |
| 7 | 96.00 | 10.00% |
| 8 | 97.00 | 10.00% |
| 9 | 98.00 | 7.50% |
| 10 | 98.50 | 5.00% |
| 11 | 99.00 | 3.75% |
| 12 | 99.25 | 2.50% |
| 13 | 99.50 | 2.50% |
| 14 | 99.75 | 2.00% |
| 15 | 99.90 | 1.00% |
| 16 | 99.95 | 0.45% |
| 17 | 99.99 | 0.30% |
| *18* | *70.00* | *0.00%* |

### Figure C.2 - Midpoint Riemann Sum for CTE90



# Appendix D Illustrative CLO Debt Cash Flows to Raw C-1 Factors

The following table (split into two parts) presents fields for a Baa3 CLO bond. The TR_COUPON has been transformed to a monthly interest rate. The maximum present value of deficiency (post-tax) occurs at month (PERIOD) 15 with a value of 17,343,422. This is 57.85% of original balance, so the C-1 Factor is 57.85%.

**Table D.1 - Illustrative C-1 Factor Calculation for a Baa3 CLO Bond (Part 1)**

| | BALANCE | INTEREST | PRIN | LOSSES | INT_DUE | INT_DEFERRED | TR_COUPON | TOTAL_CF | INNER_LOOP_PV | PRE_IMPAIRMENT_BV | IMPAIRMENT_FLAG | IMPAIRMENT |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | 30,000,000 | 0 | 0 | 0 | 0 | 0 | 0.00% | 0 | 10,217,245 | 30,000,000 | 0 | 0 |
| 3 | 30,000,000 | 0 | 0 | 0 | 0 | 0 | 0.64% | 0 | 10,409,684 | 30,582,112 | 0 | 0 |
| 6 | 30,000,000 | 1,330,291 | 0 | 0 | 1,330,291 | 0 | 0.64% | 1,330,291 | 9,275,458 | 29,845,229 | 0 | 0 |
| 9 | 30,000,000 | 565,331 | 0 | 0 | 565,331 | 0 | 0.62% | 565,331 | 8,884,073 | 29,852,535 | 0 | 0 |
| 12 | 30,000,000 | 565,331 | 0 | 0 | 565,331 | 0 | 0.62% | 565,331 | 8,485,348 | 29,847,038 | 0 | 0 |
| 15 | 30,571,543 | 0 | 0 | 0 | 571,543 | 571,543 | 0.62% | 0 | 8,644,476 | 30,406,768 | 1 | 21,762,292 |
| 18 | 31,141,313 | 0 | 0 | 0 | 569,770 | 1,141,313 | 0.62% | 0 | 8,806,589 | 8,806,589 | 1 | 0 |
| 21 | 31,728,151 | 0 | 0 | 0 | 586,838 | 1,728,151 | 0.62% | 0 | 8,971,741 | 8,971,741 | 1 | 0 |
| 24 | 32,332,618 | 0 | 0 | 0 | 604,467 | 2,332,618 | 0.62% | 0 | 9,139,991 | 9,139,991 | 1 | 0 |
| 27 | 32,948,601 | 0 | 0 | 0 | 615,983 | 2,948,601 | 0.62% | 0 | 9,311,396 | 9,311,396 | 1 | 0 |
| 30 | 33,562,673 | 0 | 0 | 0 | 614,072 | 3,562,673 | 0.62% | 0 | 9,486,015 | 9,486,015 | 1 | 0 |
| 33 | 34,195,140 | 0 | 0 | 0 | 632,467 | 4,195,140 | 0.62% | 0 | 9,663,909 | 9,663,909 | 1 | 0 |
| 36 | 34,846,607 | 0 | 0 | 0 | 651,467 | 4,846,607 | 0.62% | 0 | 9,845,140 | 9,845,140 | 1 | 0 |
| 39 | 35,510,485 | 0 | 0 | 0 | 663,878 | 5,510,485 | 0.62% | 0 | 10,029,768 | 10,029,768 | 1 | 0 |
| 42 | 36,179,657 | 0 | 0 | 0 | 669,172 | 6,179,657 | 0.62% | 0 | 10,217,860 | 10,217,860 | 1 | 0 |
| 45 | 36,861,439 | 0 | 0 | 0 | 681,782 | 6,861,439 | 0.62% | 0 | 10,409,478 | 10,409,478 | 1 | 0 |
| 48 | 37,563,703 | 0 | 0 | 0 | 702,263 | 7,563,703 | 0.62% | 0 | 10,604,690 | 10,604,690 | 1 | 0 |
| 51 | 38,294,902 | 0 | 0 | 0 | 731,200 | 8,294,902 | 0.62% | 0 | 10,803,563 | 10,803,563 | 1 | 0 |
| 54 | 38,992,755 | 0 | 0 | 0 | 697,852 | 8,992,755 | 0.62% | 0 | 11,006,166 | 11,006,166 | 1 | 0 |
| 57 | 39,727,548 | 0 | 0 | 0 | 734,793 | 9,727,548 | 0.62% | 0 | 11,212,567 | 11,212,567 | 1 | 0 |
| 60 | 40,500,869 | 0 | 0 | 0 | 773,320 | 10,500,869 | 0.62% | 0 | 11,422,840 | 11,422,840 | 1 | 0 |
| 63 | 41,272,468 | 0 | 0 | 0 | 771,600 | 11,272,468 | 0.62% | 0 | 11,637,056 | 11,637,056 | 1 | 0 |
| 66 | 42,041,675 | 0 | 0 | 0 | 769,206 | 12,041,675 | 0.62% | 0 | 11,855,289 | 11,855,289 | 1 | 0 |
| 69 | 42,833,923 | 0 | 0 | 0 | 792,248 | 12,833,923 | 0.62% | 0 | 12,077,615 | 12,077,615 | 1 | 0 |
| 72 | 43,641,101 | 0 | 0 | 0 | 807,178 | 13,641,101 | 0.62% | 0 | 12,304,110 | 12,304,110 | 1 | 0 |
| 75 | 44,472,526 | 0 | 0 | 0 | 831,426 | 14,472,526 | 0.62% | 0 | 12,534,853 | 12,534,853 | 1 | 0 |
| 78 | 45,301,373 | 0 | 0 | 0 | 828,847 | 15,301,373 | 0.62% | 0 | 12,769,922 | 12,769,922 | 1 | 0 |
| 81 | 46,155,048 | 0 | 0 | 0 | 853,675 | 16,155,048 | 0.62% | 0 | 13,009,401 | 13,009,401 | 1 | 0 |
| 84 | 47,024,810 | 0 | 0 | 0 | 869,762 | 17,024,810 | 0.62% | 0 | 13,253,370 | 13,253,370 | 1 | 0 |
| 87 | 47,920,701 | 0 | 0 | 0 | 895,890 | 17,920,701 | 0.62% | 0 | 13,501,914 | 13,501,914 | 1 | 0 |
| 90 | 48,823,735 | 0 | 0 | 0 | 903,035 | 18,823,735 | 0.62% | 0 | 13,755,120 | 13,755,120 | 1 | 0 |
| 93 | 49,743,787 | 0 | 0 | 0 | 920,052 | 19,743,787 | 0.62% | 0 | 14,013,073 | 14,013,073 | 1 | 0 |
| 96 | 50,691,478 | 0 | 0 | 0 | 947,691 | 20,691,478 | 0.62% | 0 | 14,275,865 | 14,275,865 | 1 | 0 |
| 99 | 51,657,223 | 0 | 0 | 0 | 965,745 | 21,657,223 | 0.62% | 0 | 14,543,584 | 14,543,584 | 1 | 0 |
| 102 | 52,619,973 | 0 | 0 | 0 | 962,750 | 22,619,973 | 0.62% | 0 | 14,816,324 | 14,816,324 | 1 | 0 |
| 105 | 53,611,563 | 0 | 0 | 0 | 991,589 | 23,611,563 | 0.62% | 0 | 15,094,179 | 15,094,179 | 1 | 0 |
| 108 | 54,632,940 | 0 | 0 | 0 | 1,021,377 | 24,632,940 | 0.62% | 0 | 15,377,245 | 15,377,245 | 1 | 0 |
| 111 | 0 | 1,040,836 | 14,624,783 | 40,008,157 | 1,040,836 | 10,008,157 | 0.62% | 15,665,619 | 0 | 0 | 1 | 0 |

## Table D.2 - Illustrative C-1 Factor Calculation for a Baa3 CLO Bond (Part 2)

| | POST_IMPAIRMENT_BV | RISK_PREMIUM | PV_ACCUM_DEFICIENCY | TAX_BASIS | UNREALIZED_TAX_LOSS | REALIZED_TAX_LOSS | DTA_CHANGE | PV_ACCUM_DEFICIENCY_TAX_ADJ |
|---|---|---|---|---|---|---|---|---|
| 0 | 30,000,000 | 0 | 0 | 30,000,000 | 0 | 0 | 0 | 0 |
| 3 | 30,582,112 | -9,226 | -27,342 | 30,000,000 | -582,112 | 0 | 32,807 | 69,974 |
| 6 | 29,845,229 | -9,003 | -54,579 | 30,000,000 | 154,771 | 0 | -190,045 | -79,235 |
| 9 | 29,852,535 | -9,006 | -81,145 | 30,000,000 | 147,465 | 0 | -63,425 | -104,510 |
| 12 | 29,847,038 | -9,004 | -107,478 | 30,000,000 | 152,962 | 0 | -63,431 | -131,710 |
| 15 | 8,644,476 | -2,608 | 20,712,379 | 30,571,543 | 21,927,067 | 0 | -3,720,545 | 17,343,422 |
| 18 | 8,806,589 | -2,657 | 20,704,838 | 31,141,313 | 22,334,725 | 0 | -86,587 | 17,270,132 |
| 21 | 8,971,741 | -2,706 | 20,697,221 | 31,728,151 | 22,756,410 | 0 | -89,283 | 17,194,954 |
| 24 | 9,139,991 | -2,757 | 20,689,529 | 32,332,618 | 23,192,627 | 0 | -92,070 | 17,117,836 |
| 27 | 9,311,396 | -2,809 | 20,681,760 | 32,948,601 | 23,637,205 | 0 | -93,827 | 17,039,778 |
| 30 | 9,486,015 | -2,862 | 20,673,913 | 33,562,673 | 24,076,658 | 0 | -93,325 | 16,962,912 |
| 33 | 9,663,909 | -2,915 | 20,665,989 | 34,195,140 | 24,531,231 | 0 | -96,231 | 16,884,066 |
| 36 | 9,845,140 | -2,970 | 20,657,985 | 34,846,607 | 25,001,467 | 0 | -99,235 | 16,803,185 |
| 39 | 10,029,768 | -3,026 | 20,649,901 | 35,510,485 | 25,480,716 | 0 | -101,128 | 16,721,320 |
| 42 | 10,217,860 | -3,082 | 20,641,737 | 36,179,657 | 25,961,797 | 0 | -101,823 | 16,639,580 |
| 45 | 10,409,478 | -3,140 | 20,633,492 | 36,861,439 | 26,451,961 | 0 | -103,742 | 16,556,867 |
| 48 | 10,604,690 | -3,199 | 20,625,164 | 37,563,703 | 26,959,012 | 0 | -106,981 | 16,472,018 |
| 51 | 10,803,563 | -3,259 | 20,616,754 | 38,294,902 | 27,491,339 | 0 | -111,636 | 16,383,810 |
| 54 | 11,006,166 | -3,320 | 20,608,259 | 38,992,755 | 27,986,589 | 0 | -105,823 | 16,301,551 |
| 57 | 11,212,567 | -3,382 | 20,599,680 | 39,727,548 | 28,514,981 | 0 | -111,815 | 16,214,802 |
| 60 | 11,422,840 | -3,446 | 20,591,016 | 40,500,869 | 29,078,029 | 0 | -118,070 | 16,123,403 |
| 63 | 11,637,056 | -3,511 | 20,582,265 | 41,272,468 | 29,635,412 | 0 | -117,558 | 16,033,286 |
| 66 | 11,855,289 | -3,576 | 20,573,427 | 42,041,675 | 30,186,386 | 0 | -116,930 | 15,944,542 |
| 69 | 12,077,615 | -3,643 | 20,564,500 | 42,833,923 | 30,756,308 | 0 | -120,570 | 15,853,515 |
| 72 | 12,304,110 | -3,712 | 20,555,485 | 43,641,101 | 31,336,991 | 0 | -122,843 | 15,761,402 |
| 75 | 12,534,853 | -3,781 | 20,546,380 | 44,472,526 | 31,937,674 | 0 | -126,678 | 15,666,912 |
| 78 | 12,769,922 | -3,852 | 20,537,184 | 45,301,373 | 32,531,451 | 0 | -126,001 | 15,573,862 |
| 81 | 13,009,401 | -3,925 | 20,527,897 | 46,155,048 | 33,145,648 | 0 | -129,924 | 15,478,418 |
| 84 | 13,253,370 | -3,998 | 20,518,517 | 47,024,810 | 33,771,441 | 0 | -132,373 | 15,381,835 |
| 87 | 13,501,914 | -4,073 | 20,509,044 | 47,920,701 | 34,418,786 | 0 | -136,505 | 15,282,761 |
| 90 | 13,755,120 | -4,149 | 20,499,476 | 48,823,735 | 35,068,616 | 0 | -137,442 | 15,183,838 |
| 93 | 14,013,073 | -4,227 | 20,489,812 | 49,743,787 | 35,730,714 | 0 | -140,034 | 15,083,736 |
| 96 | 14,275,865 | -4,307 | 20,480,053 | 50,691,478 | 36,415,613 | 0 | -144,404 | 14,981,052 |
| 99 | 14,543,584 | -4,387 | 20,470,196 | 51,657,223 | 37,113,639 | 0 | -147,160 | 14,877,117 |
| 102 | 14,816,324 | -4,470 | 20,460,241 | 52,619,973 | 37,803,649 | 0 | -146,374 | 14,774,766 |
| 105 | 15,094,179 | -4,553 | 20,450,187 | 53,611,563 | 38,517,383 | 0 | -150,931 | 14,669,780 |
| 108 | 15,377,245 | -4,639 | 20,440,032 | 54,632,940 | 39,255,695 | 0 | -155,641 | 14,562,086 |
| 111 | 0 | 0 | 20,433,206 | 0 | 0 | -6,721,370 | 6,562,759 | 14,456,749 |

# Appendix E Risk Premium Comparison

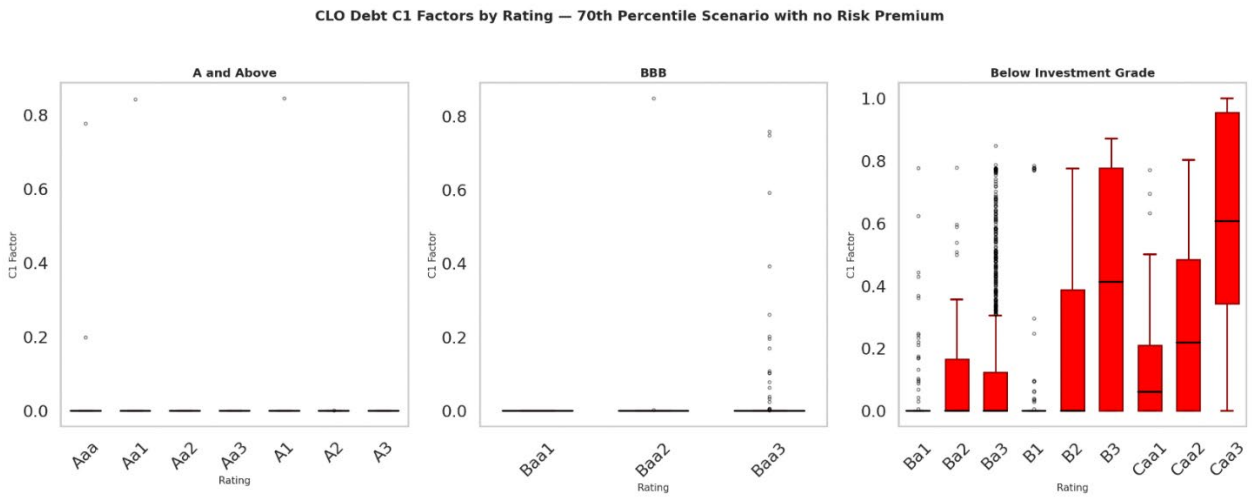
In the ACLI/MA Bond Model, the risk premium is assigned by rating and is estimated as half a standard deviation above the mean present value of losses. For a standard normal distribution, the 69.15th percentile is one-half of a standard deviation above the mean. Therefore, the Academy considers the 70th percentile. After calculating the 70th percentile C-1 (assuming a risk premium of 0), the Academy observes erratic results; contrary to expectation, the factors do not strictly increase as credit quality declines.

**Table E.1 - Comparison of VaR70 ACLI/MA Bond Model vs. Collateral Model**

| Rating | Risk Premium | | Difference |
|---|---|---|---|
| | ACLI/MA Bond Model | 70th Percentile of CLOs | |
| Aaa | 0.007% | 0.026% | 0.019% |
| Aa1 | 0.015% | 0.284% | 0.269% |
| Aa2 | 0.032% | 0.000% | -0.032% |
| Aa3 | 0.046% | 0.000% | -0.046% |
| A1 | 0.065% | 0.343% | 0.278% |
| A2 | 0.092% | 0.000% | -0.092% |
| A3 | 0.123% | 0.000% | -0.123% |
| Baa1 | 0.168% | 0.000% | -0.168% |
| Baa2 | 0.229% | 0.239% | 0.010% |
| Baa3 | 0.362% | 0.197% | -0.165% |
| Ba1 | 0.579% | 4.527% | 3.948% |
| Ba2 | 0.932% | 10.119% | 9.187% |
| Ba3 | 1.225% | 9.709% | 8.484% |
| B1 | 1.619% | 4.240% | 2.621% |
| B2 | 2.168% | 20.487% | 18.319% |
| B3 | 2.834% | 39.888% | 37.054% |
| Caa1 | 3.787% | 14.195% | 10.408% |
| Caa2 | 5.274% | 28.978% | 23.704% |
| Caa3 | 7.998% | 58.960% | 50.962% |

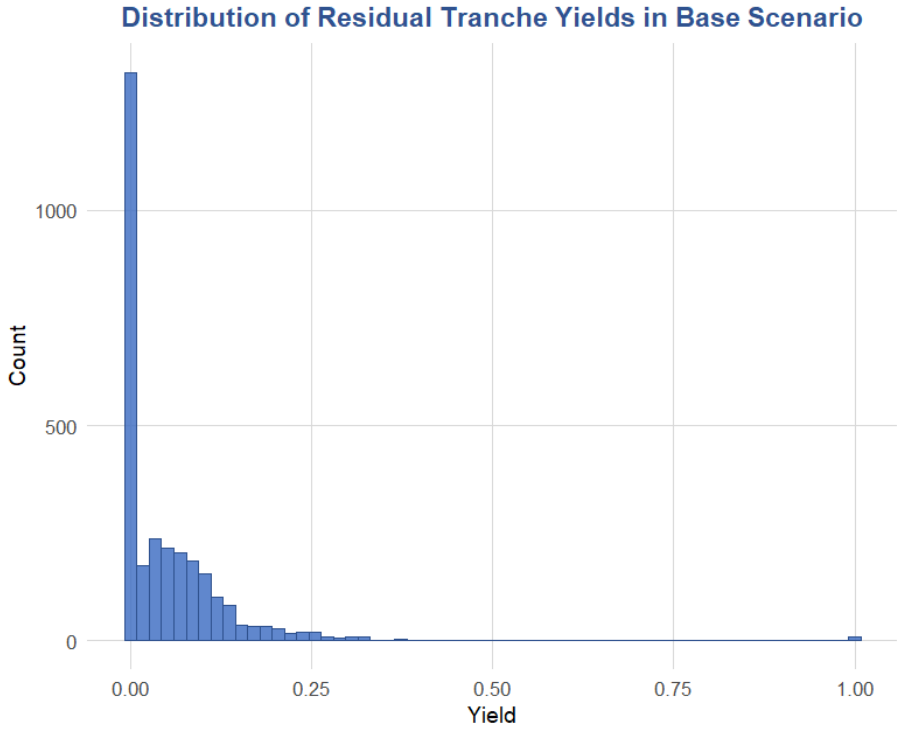
Additionally, the box plot reveals that for investment-grade bonds, the 70th percentile factors would be 0 but for outlier results. This means any risk premium derived from the 70th percentile will be predominantly relying on outliers rather than on clusters around a mean.

**Figure E.1 - CLO Debt Raw C-1 Factors at VaR70 by Rating**

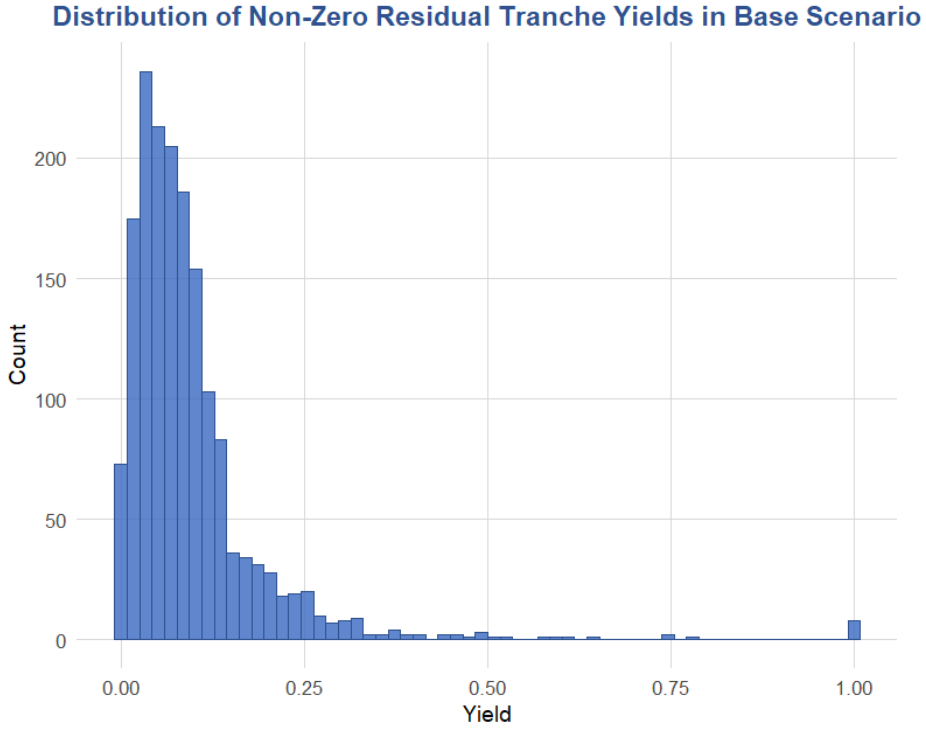


# Appendix F Mean Scenario Residual Tranche IRRs

When running the baseline "mean scenario" projections, the Academy runs CDOnet with the mean default rates per year by credit rating and the mean recovery rates. The residual tranche IRRs are calculated from the net cash flows (principal + interest) from first contribution to last distribution, capping at 0% and 100%. The Academy observes that 42.55% of residual tranches have a 0% IRR under the mean scenario.




| Statistic | Value |
|---|---|
| Mean | 0.0542 |
| Standard Deviation | 0.0914 |
| 5th Percentile | 0.0000 |
| 10th Percentile | 0.0000 |
| 25th Percentile | 0.0000 |
| 50th Percentile | 0.0229 |
| 75th Percentile | 0.0804 |
| 90th Percentile | 0.1358 |
| 95th Percentile | 0.1986 |




| Statistic | Value |
|---|---|
| Mean | 0.0943 |
| Standard Deviation | 0.1037 |
| 5th Percentile | 0.0095 |
| 10th Percentile | 0.0187 |
| 25th Percentile | 0.0379 |
| 50th Percentile | 0.0706 |
| 75th Percentile | 0.1128 |
| 90th Percentile | 0.1877 |
| 95th Percentile | 0.2495 |

# Appendix G Tested Regressions for Comparable Attributes

The Academy's baseline for comparable attributes is ratings-only. The following regressions were run against other comparable attributes. These include (but are not limited to):

a) Attachment and detachment points (AP and DP respectively; "tranche thickness" is derived as the difference between DP and AP)
b) Interest coverage and overcollateralization (tests, ratios and levels)
c) Flags for the levels of subordination (senior, mezzanine, junior)
d) Current and initial balance of the CLO tranche (ratios of current-to-original and current tranche-to-current deal are derived)
e) Number of years until the end of reinvestment and until the formal maturity
f) The coupon rate
g) Collateral credit quality (WARF and the proportion in each rating)
h) Collateral weighted average time to maturity
i) Total balance and number of unique issuers and assets within the collateral

The Academy observes that when running simple OLS and without transforming any variable, ratings explain more variance than all other attributes. The Academy does observe that attachment and detachment points are explanatory when divided up into sufficiently many buckets (e.g., 1–2%, 2–3%, etc.).

## Table G.1 - Tested Regressions for Potential Comparable Attributes

| Regression Exogenous Variables | Adj $R^2$ | # of Parameters | Notes |
|---|---|---|---|
| All Variables, excluding Rating (no transformations) | 42.64% | 47 | Baseline estimate for non-rating characteristics |
| AP Percentile Buckets (50 equal-sized) | 66.54% | 50 | |
| Tranche Thickness Percentile Buckets (50 equal-sized) | 45.29% | 50 | |
| DP Percentile Buckets (50 equal-sized) | 76.47% | 50 | New baseline for non-rating characteristics. Downside: agnostic towards underlying credit quality. |
| Rating | 74.22% | 19 | Baseline for ratings. Explanatory power comparable to detachment point |
| Rating + DP | 74.42% | 20 | Adds little additional explanatory power over rating |
| Rating + DP Buckets | 81.82% | 68 | Explains an additional 7.6% of variance over ratings only |
| Rating + Reinv Horizon | 76.23% | 20 | Reinvestment horizon explains an additional 2.0% of variance over ratings only; is the most explanatory variable when added to rating (w/o transformation) |
| Rating + Reinv Horizon x Rating (interaction terms with rating) | 82.42% | 37 | Explains an additional 8.2% of variance over ratings only; potential overfitting on thin tranches |
| Rating + Reinv Horizon x Rating Letter (interactions with AAA, AA, A, etc.) | 81.58% | 26 | Loses less than 1% of variance explained Adds credibility to non-standard tranches |
| Rating + Reinv Horizon x Rating Bucket (interactions with B3/below, B2/B1/Ba3, Baa3/Ba1/Ba2, etc.) | 81.63% | 26 | Comparable $R^2$ as rating letter; adds credibility to CCC (adds observations and adds variance in horizon) |
| Rating + Reinv Horizon x Rating Bucket + Tranche Coupon | 82.34% | 27 | Minor improvement over model without tranche coupon |
| Rating + Reinv Horizon x Rating Bucket + DP | 81.72% | 27 | Negligible improvement over model without DP |
| Rating + Reinv Horizon x Rating Bucket + DP | 85.63% | 75 | Detachment point (at the granular level) explains an additional 4.0% of variance |
| Rating + Reinv Horizon x Rating Bucket + Thickness | 81.66% | 27 | Negligible improvement over model without thickness |
| Rating + Reinv Horizon x Rating Bucket + Flag for [Thickness ≤ 4% & Baa3/below Rating] | 83.25% | 27 | Explains additional 1.6% of variance over model without thickness or DP; chosen model |
| Rating + Reinv Horizon x Rating Bucket + Flag for [Thickness ≤ 4% & Baa3/below Rating] + Tranche Coupon | 83.71% | 28 | Explains only 0.5% additional variance Without tranche thickness, coupon added 0.75%; this suggests that coupon rate is a proxy |
| Rating + Reinv Horizon x Rating Bucket + Flag for [Thickness ≤ 4% & Baa3/below Rating] * Rating | 84.34% | 36 | Explains only 1% additional variance with 9 additional variables; potential overfitting for below-IG |
| Rating + Reinv Horizon x Rating Bucket + Flag for [Thickness ≤ 4% & Baa3/below Rating] + DP Buckets | 85.70% | 76 | Reference point: granular detachment point data only explains an additional 2.5% of variance over chosen model |

# Appendix H Tranche Thickness Kernel Density

Kernel density estimation (KDE) is a non-parametric technique for estimating the probability density function of a continuous random variable without imposing a parametric distributional assumption. Given a sample of n observed thickness values $x_1, x_2, \ldots, x_n$, the KDE estimator evaluates the density at any point x as

$$\hat{f}(x) = \frac{1}{nh} \times \sum_{i=1}^{n} K\left(\frac{x - x_i}{h}\right)$$

where $h$ is the bandwidth and $K$ is the Gaussian kernel function, where $K(u) = \frac{1}{\sqrt{2\pi}} \times e^{-\frac{u^2}{2}}$. The density is evaluated on a fine grid of n = 2,048 equally spaced points spanning the support of the data, producing a smooth continuous approximation of the empirical thickness distribution. The bandwidth is selected using Silverman's Rule of Thumb, which minimizes the mean integrated squared error (MISE) under the assumption that the true density is Gaussian: $h = 0.9 \times \min\left(\hat{\sigma}, \frac{IQR}{1.34}\right) \times n^{-\frac{1}{5}}$, $\hat{\sigma}$ is the sample standard deviation and IQR is the interquartile range. Because tranche thickness distributions are typically multimodal and right-skewed (Silverman's rule tends to over-smooth in such cases), the bandwidth is further scaled by a factor of 0.4 to sharpen the resolution of distinct thickness clusters. This multiplier was selected through visual inspection of the resulting density estimates across rating tiers and can be tuned as needed.

The densities of thickness for each Baa1 and below rating are in the figures below.

## Figure H.1 - Kernel Density Estimation for Tranche Thickness (Baa1 through Ba1)

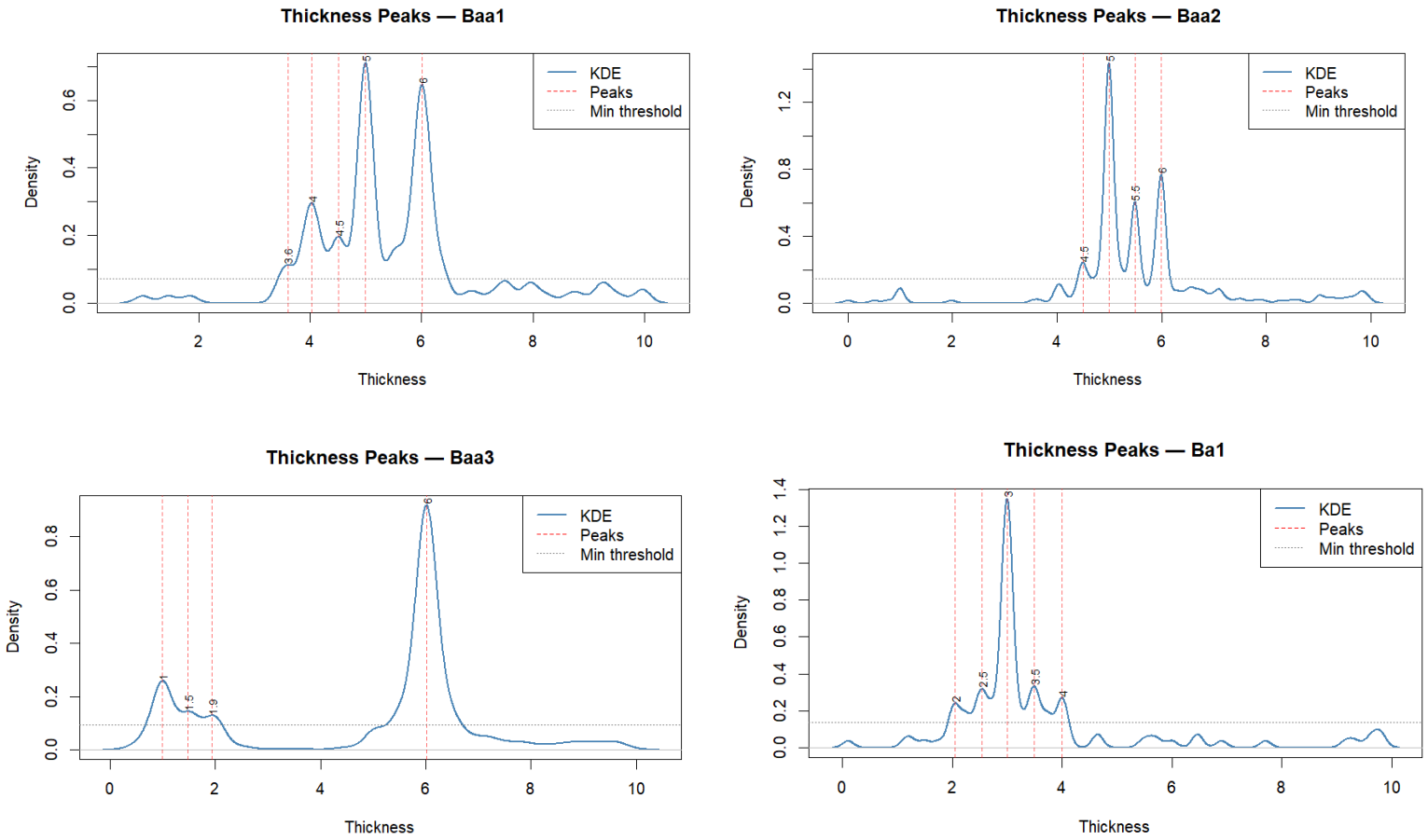


**Figure H.2 - Kernel Density Estimation for Tranche Thickness (Ba2 through B2)**

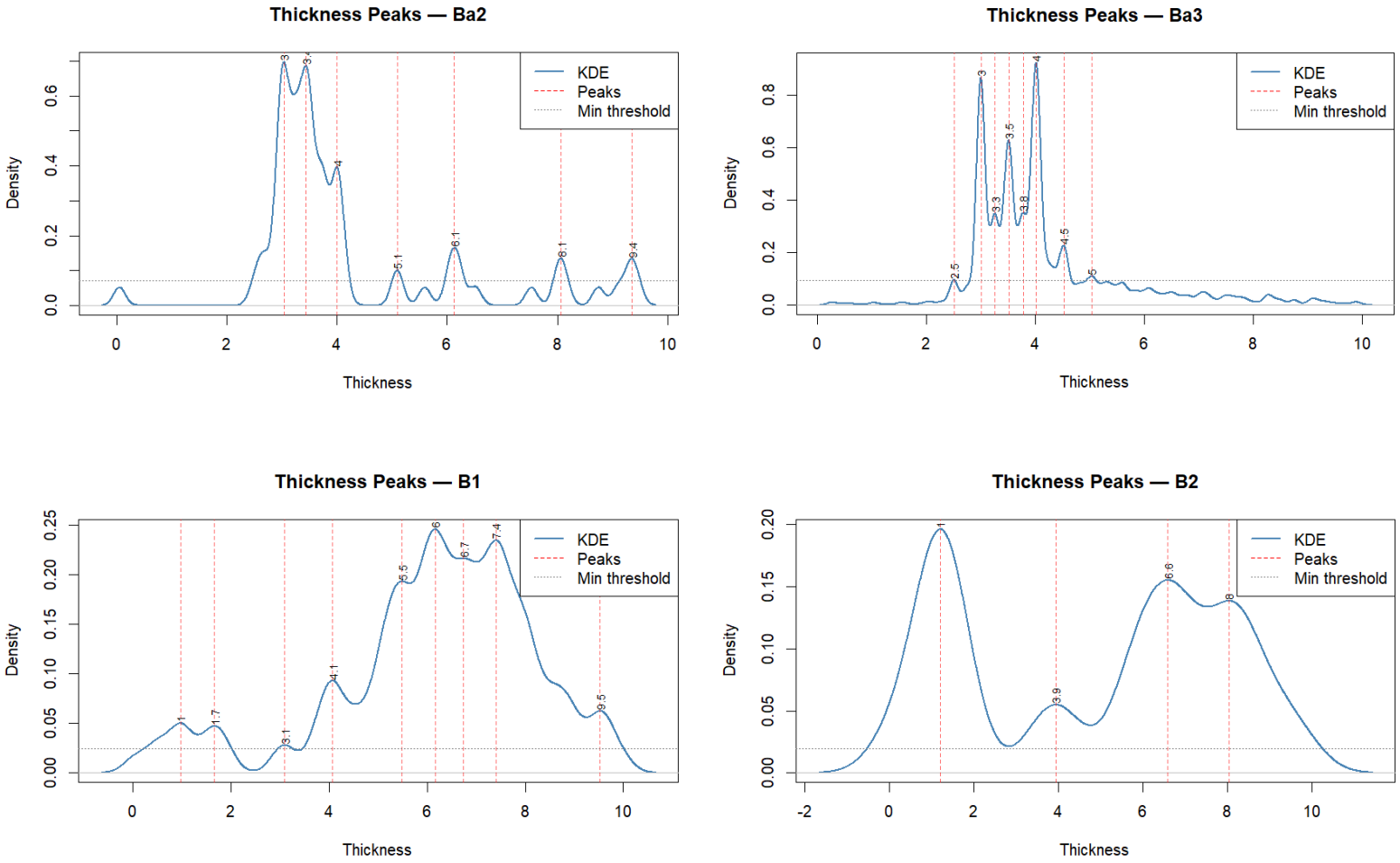
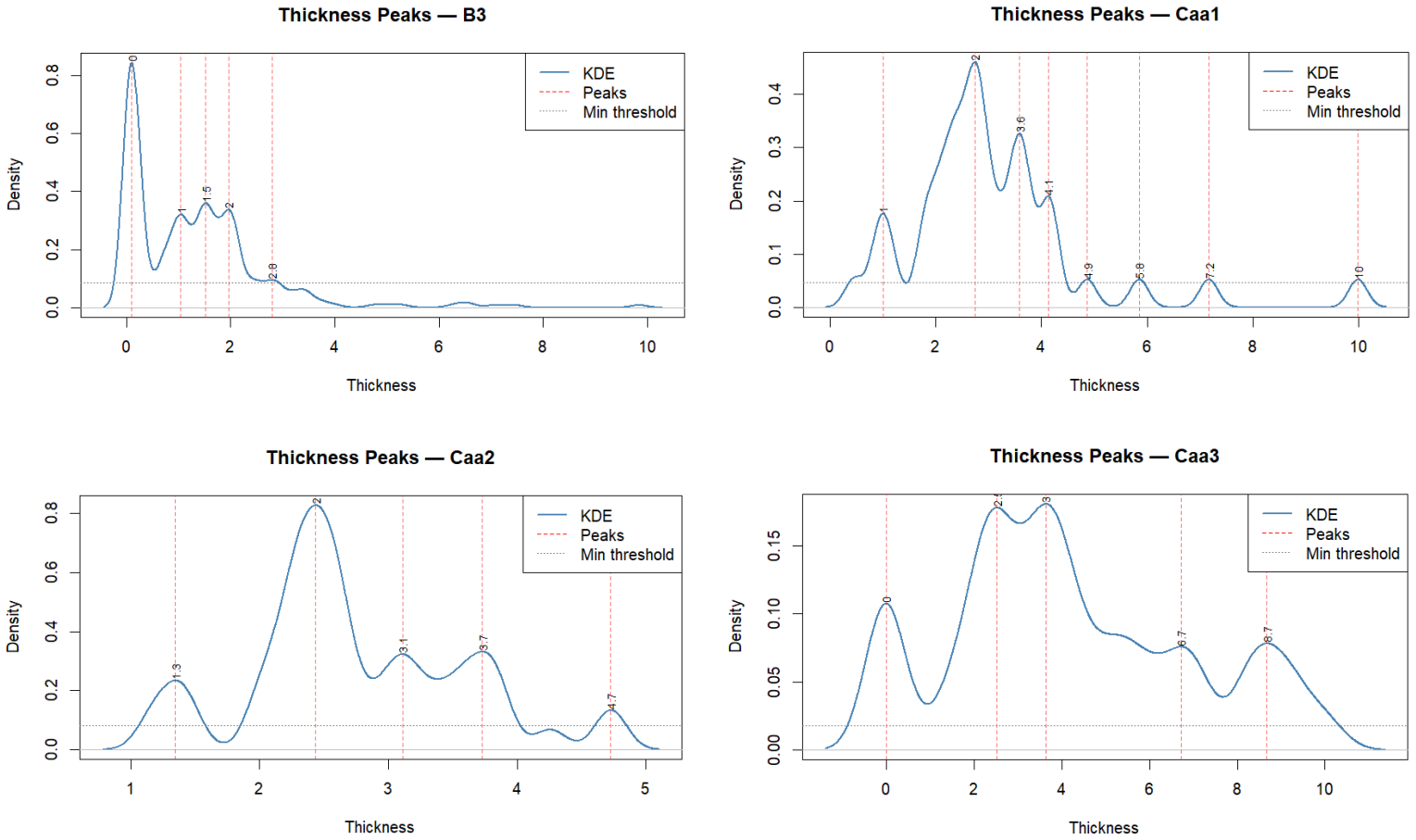


**Figure H.3 - Kernel Density Estimation for Tranche Thickness (B3 through Caa3)**



# Appendix I "Thin" vs. "Thick" Tranche Average C-1 Factors

In the proposed factors, the Academy defines "thin" to be ≤4% thickness and "thick" to be >4% thickness. The 4% cutoff was chosen because it is a clean round number that distinguishes the two groups of Baa3 CLOs. However, within lower credit quality—Ba3 in particular—4% and 4.5% are common thicknesses. See Appendix H. The Academy thus presents 4.25% as an alternative cutoff point, as it is the midpoint of 4% and 4.5% and is within the range where no Baa3 bonds exist.

**Table I.1 - Distribution of Balance by Rating and Thickness**

| | Distribution of Current Balance ($), by Rating and Thickness | | | |
|---|---|---|---|---|
| Rating | Thickness ≤ 4% | Thickness > 4% | Thickness ≤ 4.25% | Thickness > 4.25% |
| Aaa | 7,019,535,647 | 529,970,994,807 | 7,953,685,647 | 529,036,844,807 |
| Aa1 | 86,400,000 | 12,890,962,056 | 86,400,000 | 12,890,962,056 |
| Aa2 | 303,372,000 | 87,668,358,271 | 333,372,000 | 87,638,358,271 |
| Aa3 | - | 1,892,554,504 | - | 1,892,554,504 |
| A1 | 283,875,000 | 6,180,587,500 | 447,875,000 | 6,016,587,500 |
| A2 | 254,640,000 | 43,354,520,095 | 254,640,000 | 43,354,520,095 |
| A3 | 18,750,000 | 1,143,245,000 | 18,750,000 | 1,143,245,000 |
| Baa1 | 209,400,000 | 3,752,736,650 | 392,860,000 | 3,569,276,650 |
| Baa2 | 148,550,000 | 7,966,005,000 | 269,650,000 | 7,844,905,000 |
| Baa3 | 3,215,270,000 | 40,771,318,439 | 3,215,270,000 | 40,771,318,439 |
| Ba1 | 1,276,616,000 | 664,139,600 | 1,348,236,000 | 592,519,600 |
| Ba2 | 752,065,000 | 660,259,566 | 845,635,000 | 566,689,566 |
| Ba3 | 14,235,703,060 | 15,597,030,288 | 18,483,360,560 | 11,349,372,788 |
| B1 | 109,948,000 | 3,151,314,126 | 220,948,000 | 3,040,314,126 |
| B2 | 52,739,000 | 369,455,200 | 68,739,000 | 353,455,200 |
| B3 | 1,551,315,000 | 178,364,579 | 1,551,315,000 | 178,364,579 |
| Caa1 | 304,189,379 | 265,904,272 | 355,036,500 | 215,057,151 |
| Caa2 | 399,260,363 | 80,152,584 | 399,260,363 | 80,152,584 |
| Caa3 | 236,423,988 | 624,413,779 | 250,823,988 | 610,013,779 |

**Figure I.1 - Comparison of Raw C-1 Factors under 4% vs. 4.25% Tranche Thickness (Baa1 and Baa2)**

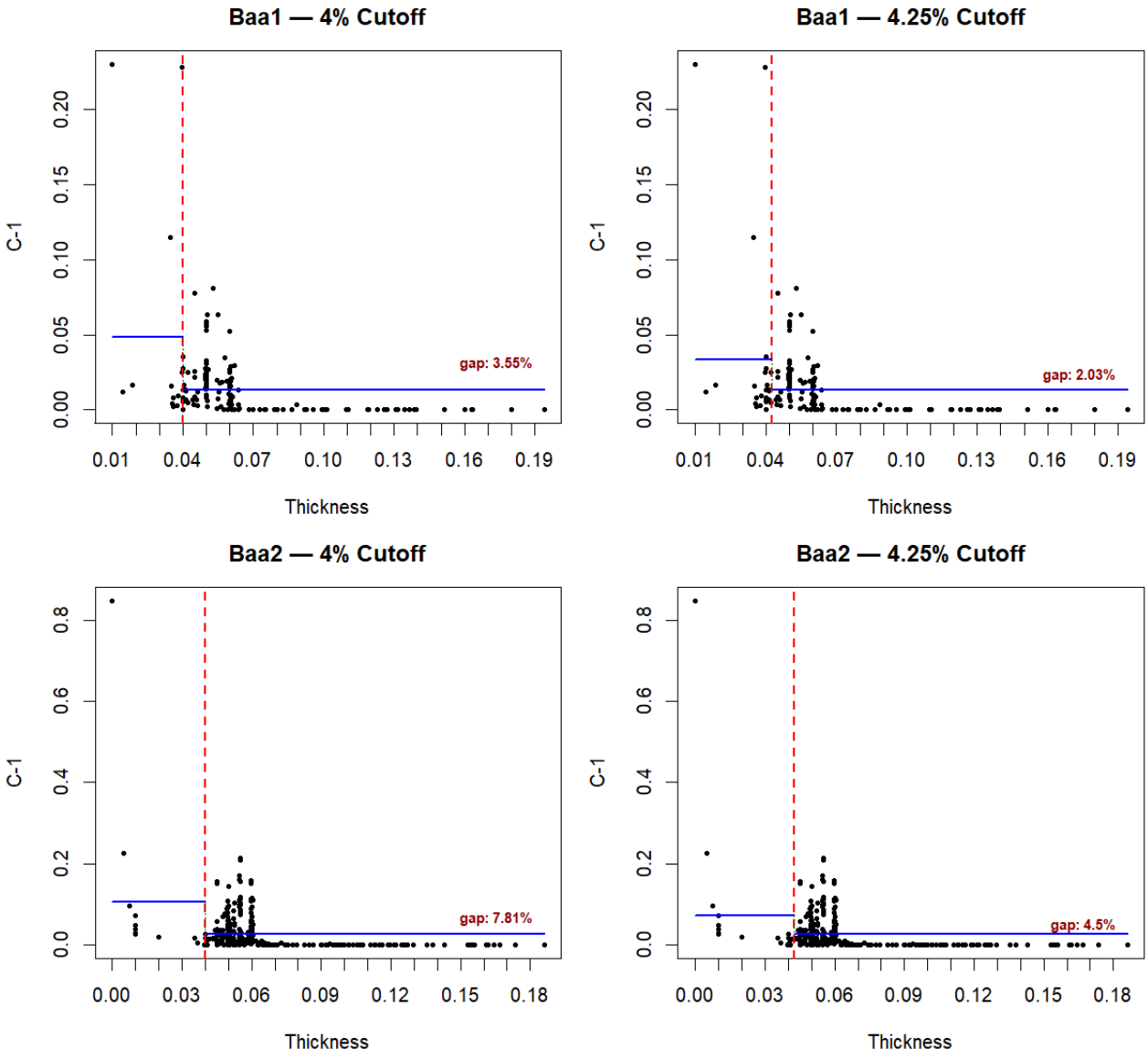


**Figure I.2 - Comparison of Raw C-1 Factors under 4% vs. 4.25% Tranche Thickness (Baa3 and Ba1)**

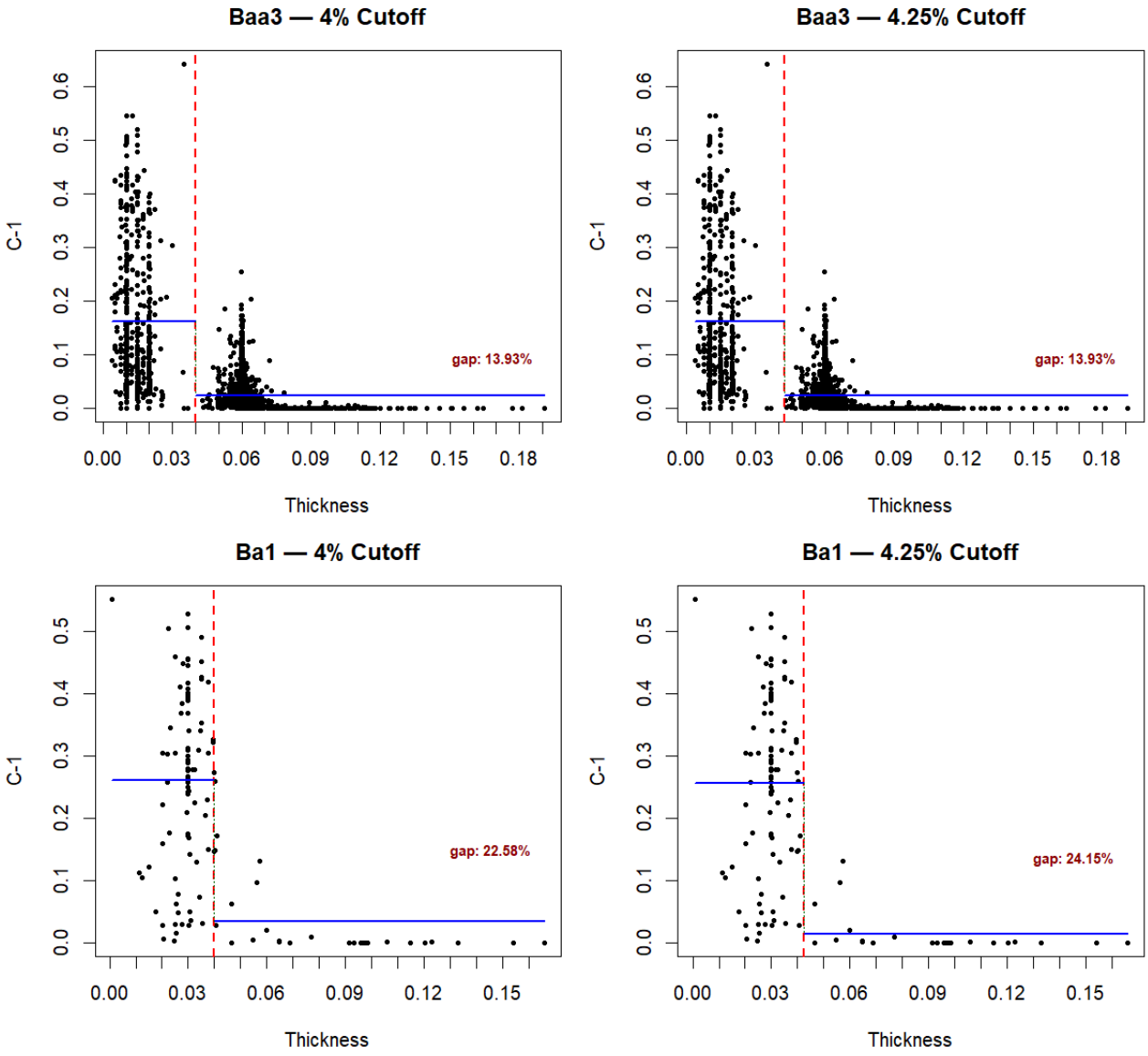


**Figure I.3 - Comparison of Raw C-1 Factors under 4% vs. 4.25% Tranche Thickness (Ba2 and Ba3)**

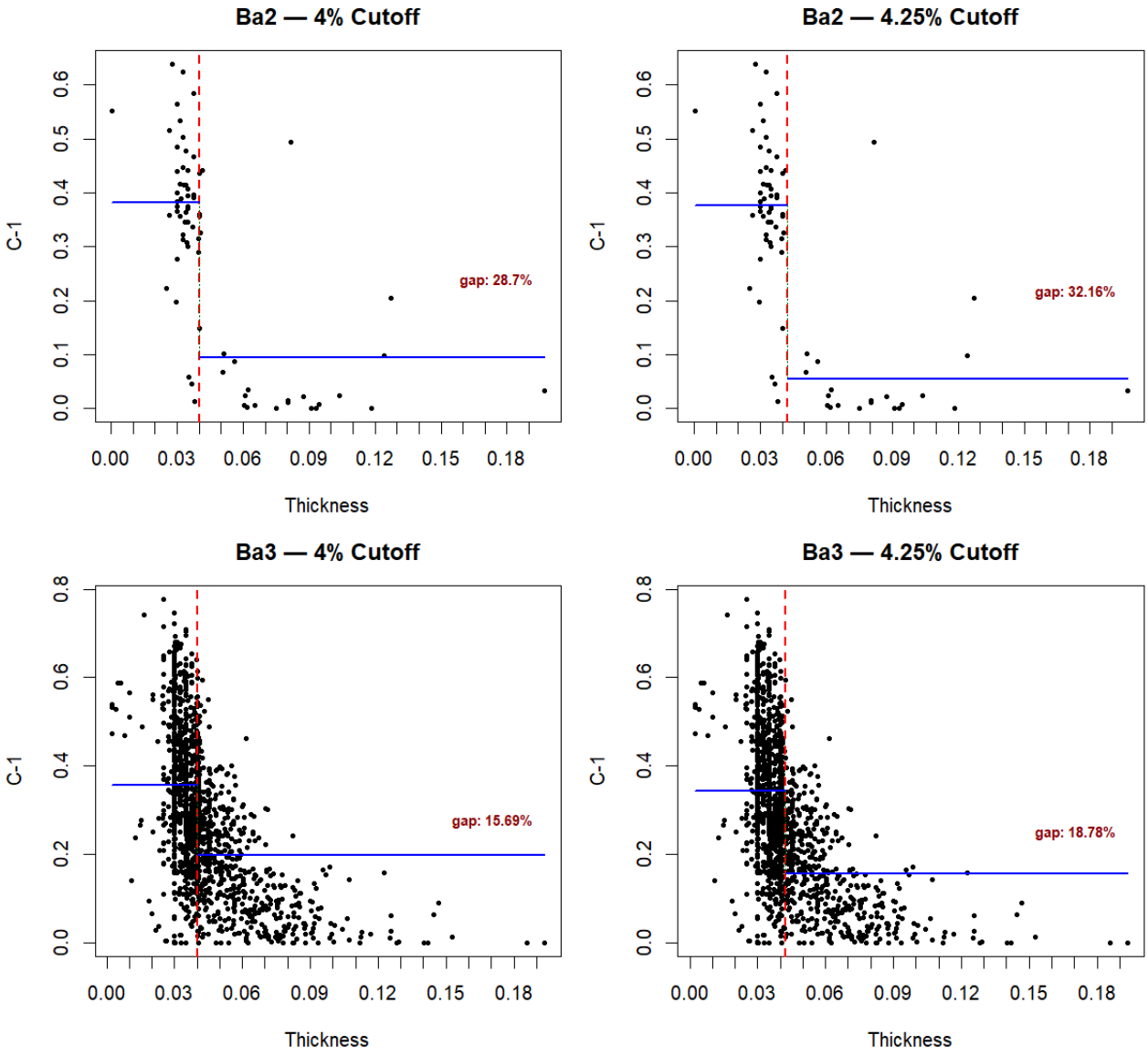


**Figure I.4 - Comparison of Raw C-1 Factors under 4% vs. 4.25% Tranche Thickness (B1 and B2)**

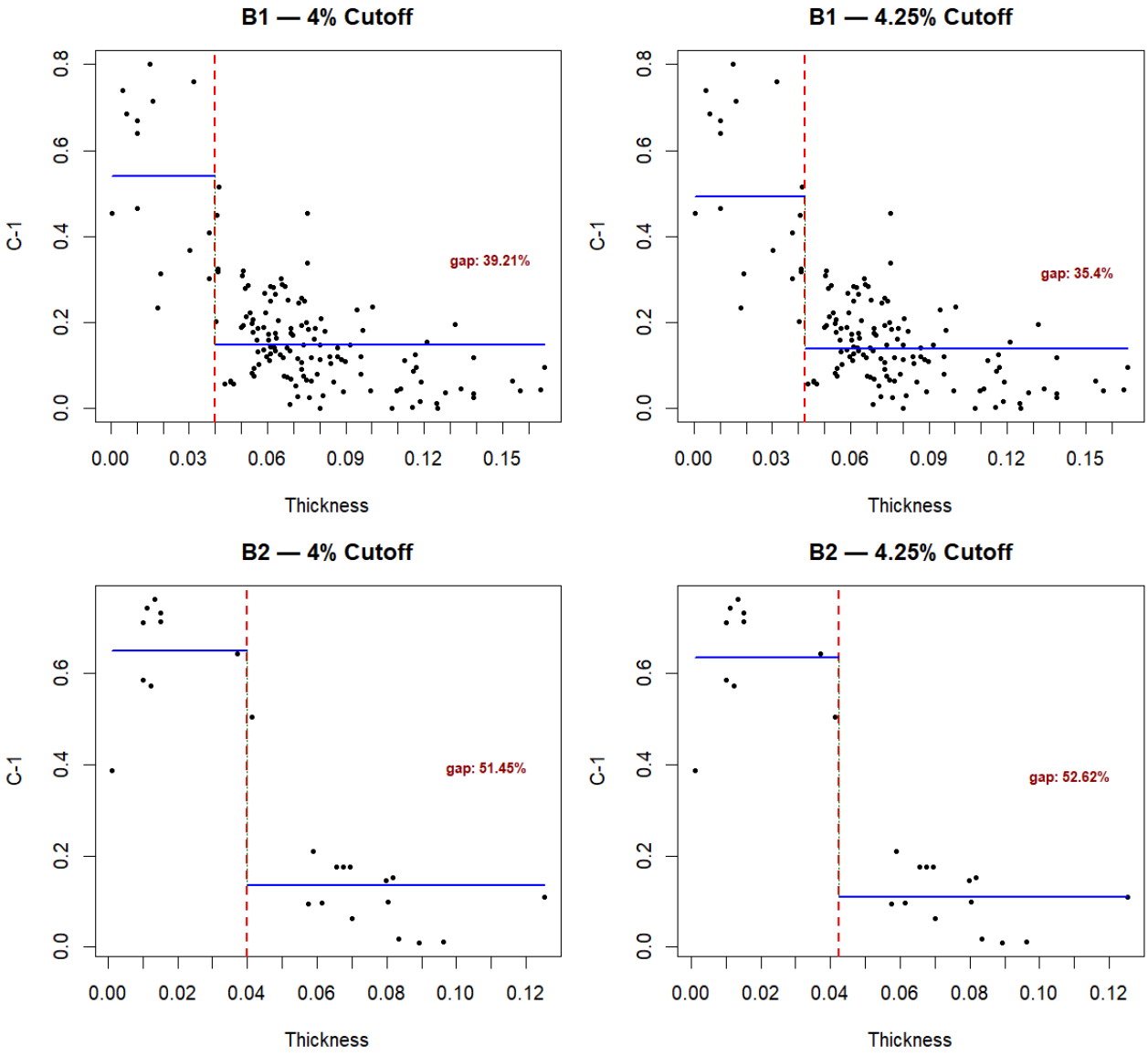


**Figure I.5 - Comparison of Raw C-1 Factors under 4% vs. 4.25% Tranche Thickness (B3 and Caa1)**

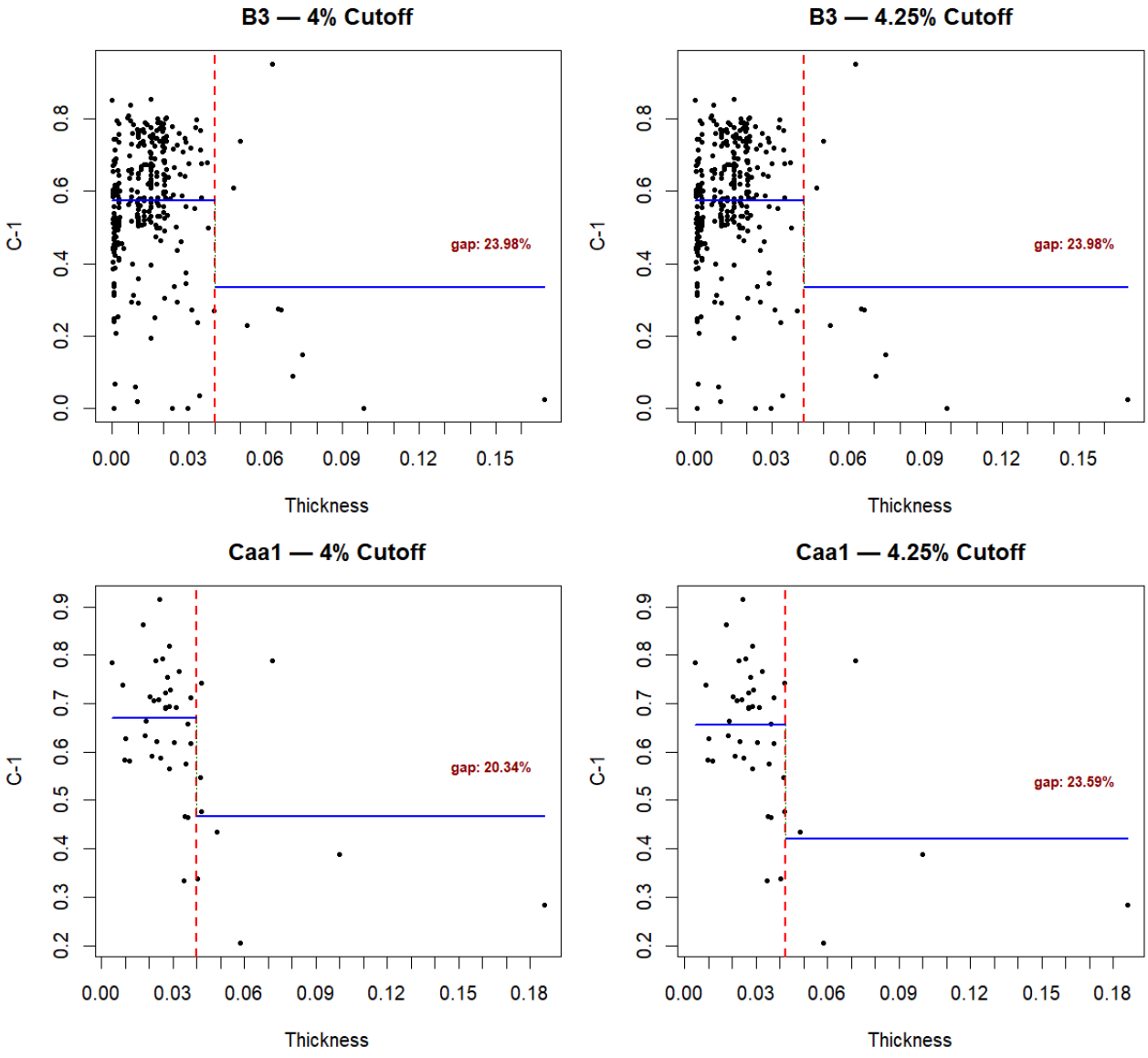
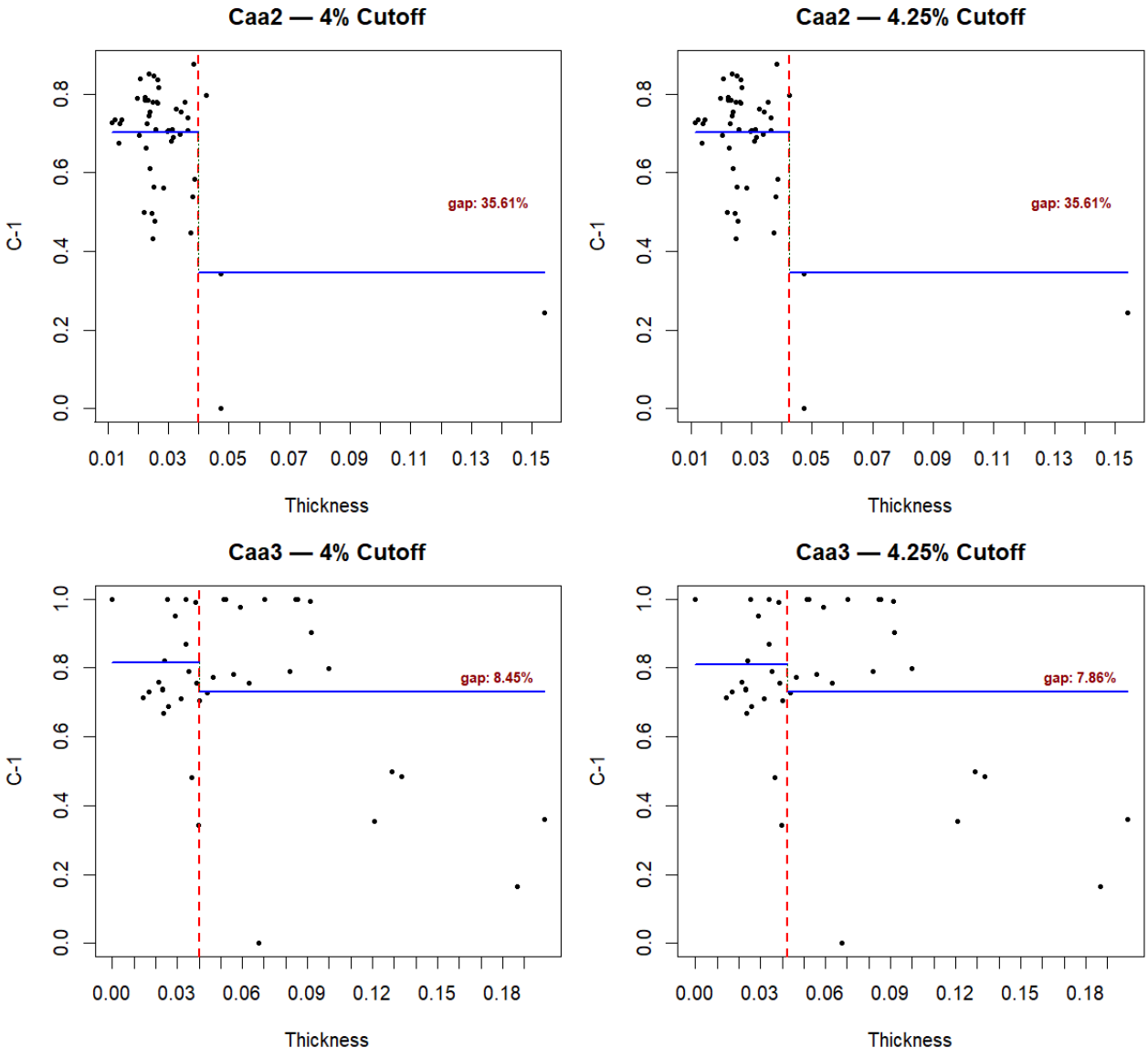


**Figure I.6 - Comparison of Raw C-1 Factors under 4% vs. 4.25% Tranche Thickness (Caa2 and Caa3)**



# Appendix J Residual Tranche Regressions

## Detachment Point, WARF, Worst Credit Rating and Interest/Principal Paid

TR_DP is the detachment point of the residual tranche.
WARF is the weighted average rating factor, as defined by Moody's Analytics.
MAX_RATING_NUM is the numeric rating (Aaa = 1, Aa1 = 2, etc.) corresponding to the CLO deal's lowest-rated debt tranche.
INT_PRIN_TO_FACE is the ratio of the sum of interest and principal already paid to the residual tranche face value.

```
Residuals:
     Min       1Q   Median       3Q      Max
-0.65564 -0.11078 -0.01858  0.09074  0.89382

Coefficients:
                  Estimate Std. Error t value Pr(>|t|)
(Intercept)       3.569e-01  3.484e-02  10.245  < 2e-16 ***
TR_DP            -8.333e-01  1.191e-01  -7.000 3.46e-12 ***
WARF              7.511e-05  8.925e-06   8.415  < 2e-16 ***
MAX_RATING_NUM    9.674e-03  2.058e-03   4.701 2.76e-06 ***
INT_PRIN_TO_FACE -5.466e-01  1.180e-02 -46.320  < 2e-16 ***
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Residual standard error: 0.1639 on 2060 degrees of freedom
Multiple R-squared:  0.5148,    Adjusted R-squared:  0.5139
F-statistic: 546.5 on 4 and 2060 DF,  p-value: < 2.2e-16
```

## Detachment Point, WARF, Interest/Principal Paid and Ratio of CLO Balance in Low Credit Tranches

PROP_BAA1_OR_WORSE is the proportion of debt tranches rated Baa1 or worse, by balance, per CLO.

```
Residuals:
     Min       1Q   Median       3Q      Max
-0.70571 -0.10666 -0.02163  0.08987  0.88639

Coefficients:
                    Estimate Std. Error t value Pr(>|t|)
(Intercept)         5.816e-01  2.401e-02  24.223  < 2e-16 ***
TR_DP               1.690e-02  3.554e-02   0.475 0.634534
WARF                4.785e-06  7.931e-06   0.603 0.546384
INT_PRIN_TO_FACE   -5.485e-01  1.192e-02 -46.012  < 2e-16 ***
PROP_BAA1_OR_WORSE -7.424e-02  1.660e-01  -0.447 0.654668
PROP_BA1_OR_WORSE   1.069e+00  2.580e-01   4.141 3.58e-05 ***
PROP_B1_OR_WORSE    6.605e-01  1.921e-01   3.439 0.000595 ***
PROP_CAA1_OR_WORSE -5.136e-01  1.929e-01  -2.662 0.007815 **
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Residual standard error: 0.1645 on 2141 degrees of freedom
Multiple R-squared:  0.5296,    Adjusted R-squared:  0.5281
F-statistic: 344.4 on 7 and 2141 DF,  p-value: < 2.2e-16
```

## Interest/Principal Paid and Ratio of CLO Balance in Ba1 or Worse

```
Residuals:
     Min       1Q   Median       3Q      Max
-0.61871 -0.11113 -0.02463  0.08914  0.87414

Coefficients:
                  Estimate Std. Error t value Pr(>|t|)
(Intercept)       0.581491   0.007408   78.50   <2e-16 ***
INT_PRIN_TO_FACE -0.538276   0.011045  -48.73   <2e-16 ***
PROP_BA1_OR_WORSE 1.242745   0.087241   14.24   <2e-16 ***
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Residual standard error: 0.165 on 2146 degrees of freedom
Multiple R-squared:  0.5254,    Adjusted R-squared:  0.5249
F-statistic:  1188 on 2 and 2146 DF,  p-value: < 2.2e-16
```

# Appendix K Stress Tests for Six Sample Deals

## Sensitivities 1 and 2—Systematic Risk and Correlation

Systematic risk is modeled with pairwise correlation between loans. The baseline correlation is 10%. Li and Chen (2018) reference 2%, 35%, and 51% in 1-year, 5-year, and 10-year correlations for B-rated issuers. Qi et al. (2019) reference 2%, 10%, and 9% in 1-year, 5-year, and 10-year correlations for B-rated issuers.

**Table K.1 - Raw C-1 Factors on Sample Deals for Sensitivities 1 and 2**

| Rating \ Raw C-1 Factor | Baseline | Sensitivity 1<br>5% Corr | Sensitivity 2<br>20% Corr |
|---|---|---|---|
| Aaa | 0.00% | 0.00% | 0.00% |
| Aa2 | 0.00% | 0.00% | 0.05% |
| A2 | 0.04% | 0.01% | 1.24% |
| Baa2 | 0.89% | 0.04% | 8.17% |
| Baa3 | 2.34% | 0.80% | 12.58% |
| Ba3 | 30.72% | 20.18% | 52.93% |

## Sensitivity 3—Copula

The baseline assumption is a Gaussian copula. The Clayton copula may capture the asymmetric distribution of default correlations and produces fatter tails.

Table K.2 - Raw C-1 Factors on Sample Deals for Sensitivity 3

| Rating \ Raw C-1 Factor | Baseline | Sensitivity 3<br>Clayton Copula |
|---|---|---|
| Aaa | 0.00% | 0.00% |
| Aa2 | 0.00% | 0.00% |
| A2 | 0.04% | 0.08% |
| Baa2 | 0.89% | 2.21% |
| Baa3 | 2.34% | 7.57% |
| Ba3 | 30.72% | 34.04% |

## Sensitivity 4—Correlation in Severities

The baseline assumption is no correlation between recovery rates. This sensitivity tests correlated recovery rates using a Gaussian copula with 10% correlation. If recoveries are correlated with the rate of default—for example, high default environments producing lower recoveries—then recoveries will be correlated with one another.

Table K.3 - Average Raw C-1 Factors on Sample Deals for Sensitivity 4

| Rating \ Raw C-1 Factor | Baseline | Sensitivity 4<br>Correlated Severities |
|---|---|---|
| Aaa | 0.00% | 0.00% |
| Aa2 | 0.00% | 0.00% |
| A2 | 0.04% | 0.29% |
| Baa2 | 0.89% | 3.73% |
| Baa3 | 2.34% | 8.51% |
| Ba3 | 30.72% | 42.38% |

## Sensitivity 5—Recovery Average

The baseline assumption uses S&P average loss given default: 27% for senior secured loans and 60% for senior unsecured loans. A higher LGD is tested: 36% for senior secured and 54% for senior unsecured. Despite the lower LGD on senior unsecured, the overall LGD is higher in the sensitivity because the vast majority of CLO collateral is senior secured. In both cases, simple averages are not the direct input. The model uses decile data published by S&P so that the tail of the recovery distribution could be captured, and the averages for the sensitivity are fitted to the shape of S&P deciles by least-squares optimization.

Table K.4 - Average Raw C-1 Factors on Sample Deals for Sensitivity 5

| Rating \ Raw C-1 Factor | Baseline | Sensitivity 5<br>Lower Recovery |
|---|---|---|
| Aaa | 0.00% | 0.00% |
| Aa2 | 0.00% | 0.00% |
| A2 | 0.04% | 1.77% |
| Baa2 | 0.89% | 21.73% |
| Baa3 | 2.34% | 19.62% |
| Ba3 | 30.72% | 59.09% |

## Sensitivities 6 and 7—Collateral Repurchase Price and Prepayment

The baseline scenario models no prepayments and no repurchase discounts. These sensitivities model historically low prepayment speeds and purchase prices, consistent with stressed credit environments. Sensitivity 6 corresponds to the average of every observation less than or equal to the 10th percentile of the historical data of each of the prepayment speeds and purchase prices, corresponding to an 11.8% prepayment rate and a purchase price of 82.5. Sensitivity 7 applies prepayment and repurchase price equal to the VaR0.5 of historical data, corresponding to an 8.7% prepayment rate and a purchase price of 72.0.

**Table K.5 - Average Raw C-1 Factors on Sample Deals for Sensitivities 6 and 7**

| Rating \ Raw C-1 Factor | Baseline | Sensitivity 6<br>Prepay & Discount A | Sensitivity 7<br>Prepay & Discount B |
|---|---|---|---|
| Aaa | 0.00% | 0.00% | 0.00% |
| Aa2 | 0.00% | 0.00% | 0.00% |
| A2 | 0.04% | 0.07% | 0.07% |
| Baa2 | 0.89% | 0.00% | 0.00% |
| Baa3 | 2.34% | 0.55% | 0.37% |
| Ba3 | 30.72% | 10.15% | 6.67% |

**Table K.6 - Raw C-1 Factors by Sample Deal for Sensitivity 6**

| Rating \ Raw C-1 Factor | Average | Carlyle 2021-1 | Strata II | Ares 52 | Magnetite 27 | OHA 3 | Anchorage 17 |
|---|---|---|---|---|---|---|---|
| Aaa | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |
| Aa2 | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |
| A2 | 0.07% | 0.00% | 0.00% | 0.00% | 0.00% | 0.41% | 0.00% |
| Baa2 | 0.00% | 0.00% | n/a | n/a | n/a | n/a | n/a |
| Baa3 | 0.55% | 0.00% | 1.89% | 0.83% | 0.00% | 0.60% | 0.00% |
| Ba3 | 10.15% | 0.00% | 15.43% | 31.11% | 5.45% | 1.22% | 7.66% |

**Table K.7 - Raw C-1 Factors by Sample Deal for Sensitivity 7**

| Rating \ Raw C-1 Factor | Average | Carlyle 2021-1 | Strata II | Ares 52 | Magnetite 27 | OHA 3 | Anchorage 17 |
|---|---|---|---|---|---|---|---|
| Aaa | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |
| Aa2 | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |
| A2 | 0.07% | 0.00% | 0.00% | 0.00% | 0.00% | 0.41% | 0.00% |
| Baa2 | 0.00% | 0.00% | n/a | n/a | n/a | n/a | n/a |
| Baa3 | 0.37% | 0.00% | 0.81% | 0.79% | 0.00% | 0.60% | 0.00% |
| Ba3 | 6.67% | 0.00% | 10.00% | 28.68% | 0.01% | 1.22% | 0.13% |

## Sensitivities 8 and 9—Recovery, Prepayment, and Repurchase Price Combined

These sensitivities combine the lower recovery average assumption with the prepayment and repurchase price discounts tested individually above. Sensitivity 8 combines Sensitivities 5 and 6. Sensitivity 9 combines Sensitivities 5 and 7.

**Table K.8 - Average Raw C-1 Factors on Sample Deals for Sensitivities 8 and 9**

| Rating \ Raw C-1 Factor | Baseline | Sensitivities 5 & 6 | Sensitivities 5 & 7 |
|---|---|---|---|
| Aaa | 0.00% | 0.00% | 0.00% |
| Aa2 | 0.00% | 0.00% | 0.00% |
| A2 | 0.04% | 0.20% | 0.11% |
| Baa2 | 0.89% | 0.00% | 0.00% |
| Baa3 | 2.34% | 5.51% | 3.43% |
| Ba3 | 30.72% | 31.12% | 23.27% |

# Appendix L Bayesian Estimate of Frequency

Let *X* denote the observed number of default events and *Y* denote the total number of exposure trials, so that the observed (frequentist) default rate is *X* / *Y*. The objective is to estimate the true underlying default probability *p*, incorporating prior belief alongside the observed data.

Under the assumption that defaults occur independently and with constant probability *p*, the number of defaults *X* follows a Binomial distribution:

$$P(X|p,Y) = C(Y,X) \times p^X \times (1-p)^{Y-X}.$$

A flat, non-informative prior is assigned to *p*, reflecting equal prior probability across all values of $p \in [0,1]$. This Uniform distribution is equivalent to *p* ~ *Beta(*α, β*)* with α = 1, β = 1.

Because the Beta distribution is the conjugate prior for the Binomial likelihood, the posterior distribution of *p* given the observed data is also a Beta distribution and is obtained analytically via Bayes' theorem:

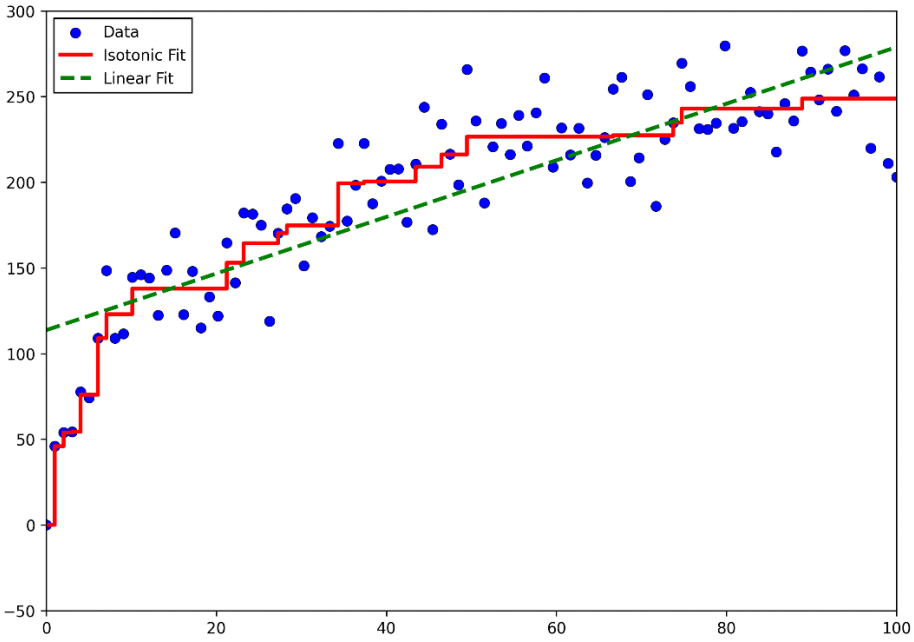
$$P(p|X,Y) \propto P(X|p,Y) \times P(p).$$

Then, $p|X,Y \sim Beta(\alpha + X, \beta + Y - X) = Beta(1 + X, 1 + Y - X)$. The expected value of a variable with beta distribution $Beta(a,b)$ is $\frac{a}{a+b}$. Therefore,

$$E[p|X,Y] = \frac{1+X}{(1+X)+(1+Y-X)} = \frac{1+X}{2+Y}.$$

# Appendix M Isotonic Regression

Figure M.1 - Illustrative Isotonic vs. Linear Regression Fit




For $x_1 \leq x_2 \leq \cdots \leq x_n$, the isotonic regression solves:

$$\min_{\hat{y}_1, \ldots, \hat{y}_n} \sum_{i=1}^{n} (y_i - \hat{y}_i)^2 \;\; s.t. \;\; \hat{y}_1 \leq \hat{y}_2 \leq \cdots \leq \hat{y}_n$$

The isotonic regression forces monotonicity, i.e., constrains data to be non-decreasing. The result is a stepwise fit where the steps correspond to weighted averages of the local points.

The Pool-Adjacent-Violators (PAV) algorithm starts with $y_i = \hat{y}_i$ and identifies points where $\hat{y}_i > \hat{y}_{i+1}$. When violations occur, the two adjacent steps are averaged together (weighted by number of points) until monotonicity is achieved.

# Appendix N CLO Ownership in 2024YE Statutory Filings

The Academy synthesizes 2024 year-end statutory filings into the table below, identifying the number of unique CLOs and the credit distribution thereof for each company (company names are scrubbed). Statutory filings are processed by S&P Global and CLOs are identified by Neuberger in the provided data. All companies are evaluated at the group level. Analysis of CLOs relative to total *Schedule D1* assets is limited to unaffiliated general account assets.

## Table N.1 - Unique CLO Deals, CLO Book Value and CLO Credit Distribution by Life Insurer, 2024YE

| # Unique CLO Deals | CLO Debt BV ($mn) | D1 BV ($mn) | Total Cash & Invested Assets ($mn) | CLO : D1 (%) | CLO : Total Assets (%) | Distribution of NAIC Credit Designations (%) | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | 1A | 1B-1C-1D | 1E-1F-1G | 2 | 3 | 4 | 5 | 6 | None |
| **811** | 21,236 | 205,624 | 333,781 | 10 | 6 | 59 | 24 | 7 | 5 | 4 | 0 | 0 | - | - |
| **753** | 5,107 | 43,589 | 57,759 | 12 | 9 | 18 | 13 | 33 | 25 | 10 | 0 | - | 0 | 0 |
| **737** | 22,175 | 136,395 | 226,890 | 16 | 10 | 11 | 25 | 36 | 28 | 0 | - | - | 0 | - |
| **605** | 3,870 | 33,060 | 44,631 | 12 | 9 | 26 | 34 | 35 | 5 | 0 | 0 | 0 | - | - |
| **574** | 9,599 | 169,969 | 235,439 | 6 | 4 | 30 | 33 | 28 | 9 | 0 | 0 | - | 0 | - |
| **501** | 6,370 | 89,179 | 140,199 | 7 | 5 | 74 | 25 | 0 | - | 0 | 0 | - | - | - |
| **466** | 6,821 | 100,220 | 163,078 | 7 | 4 | 39 | 31 | 24 | 6 | 1 | 0 | 0 | - | - |
| **457** | 2,372 | 15,699 | 28,168 | 15 | 8 | 3 | 3 | 17 | 64 | 4 | 8 | 0 | 1 | - |
| **443** | 6,922 | 24,826 | 49,839 | 28 | 14 | 6 | 5 | 17 | 59 | 12 | 1 | 0 | 0 | - |
| **424** | 3,539 | 68,358 | 110,475 | 5 | 3 | 44 | 39 | 9 | 8 | - | - | - | - | - |
| **387** | 1,970 | 22,386 | 31,989 | 9 | 6 | 8 | 6 | 13 | 55 | 17 | 0 | 0 | - | - |
| **387** | 2,197 | 51,033 | 77,488 | 4 | 3 | 40 | 39 | 11 | 9 | 1 | 0 | - | - | - |
| **374** | 4,266 | 87,997 | 118,480 | 5 | 4 | 8 | 58 | 27 | 6 | 1 | 1 | - | - | - |
| **359** | 5,189 | 59,143 | 89,594 | 9 | 6 | 44 | 18 | 21 | 15 | 3 | - | - | - | - |
| **330** | 5,367 | 151,802 | 264,775 | 4 | 2 | 45 | 31 | 15 | 7 | 1 | 0 | - | - | - |
| **316** | 2,624 | 53,875 | 90,526 | 5 | 3 | 11 | 10 | 36 | 34 | 7 | 1 | 0 | - | - |
| **312** | 8,704 | 36,755 | 50,203 | 24 | 17 | 44 | 21 | 20 | 14 | 1 | - | - | - | - |
| **307** | 2,260 | 61,754 | 81,273 | 4 | 3 | 8 | 13 | 77 | 1 | 0 | - | - | - | - |
| **285** | 737 | 4,939 | 6,403 | 15 | 12 | 40 | 35 | 22 | 3 | - | - | - | - | 0 |
| **285** | 1,930 | 28,816 | 38,652 | 7 | 5 | 5 | 24 | 65 | 6 | 0 | 1 | 0 | 0 | - |
| **265** | 9,485 | 255,985 | 349,536 | 4 | 3 | 74 | 19 | 6 | 1 | 0 | 0 | - | - | 0 |
| **251** | 1,405 | 25,119 | 31,876 | 6 | 4 | 9 | 16 | 11 | 5 | 53 | 7 | - | 0 | - |
| **247** | 1,072 | 7,855 | 9,572 | 14 | 11 | 4 | 9 | 12 | 63 | 10 | 2 | - | 1 | - |
| **241** | 751 | 6,377 | 7,604 | 12 | 10 | 4 | 5 | 23 | 56 | 13 | - | - | - | - |
| **239** | 950 | 18,607 | 32,526 | 5 | 3 | 40 | 36 | 1 | 8 | 15 | - | - | - | - |
| **238** | 8,526 | 201,782 | 323,918 | 4 | 3 | 78 | 22 | 0 | 0 | - | - | - | - | - |
| **233** | 1,421 | 22,803 | 31,939 | 6 | 4 | 14 | 38 | 27 | 21 | 0 | 0 | 0 | 0 | 0 |
| **222** | 2,185 | 15,210 | 23,436 | 14 | 9 | 32 | 19 | 44 | 6 | 0 | - | - | - | - |
| **206** | 2,652 | 29,512 | 42,946 | 9 | 6 | 8 | 21 | 16 | 37 | 13 | 2 | 1 | - | 0 |
| **204** | 1,378 | 19,497 | 24,735 | 7 | 6 | 15 | 11 | 29 | 40 | 4 | 1 | - | - | - |
| **191** | 2,087 | 27,924 | 35,779 | 7 | 6 | 36 | 37 | 12 | 14 | 1 | - | - | - | - |
| **180** | 1,433 | 14,293 | 21,584 | 10 | 7 | 13 | 4 | 46 | 37 | - | - | - | - | - |
| **177** | 3,528 | 101,514 | 182,523 | 3 | 2 | 54 | 46 | 0 | 0 | 0 | - | - | - | - |
| **175** | 1,060 | 24,678 | 30,141 | 4 | 4 | 28 | 48 | 19 | 3 | 1 | - | 0 | - | - |

| # Unique CLO Deals | CLO Debt BV ($mn) | D1 BV ($mn) | Total Cash & Invested Assets ($mn) | CLO : D1 (%) | CLO : Total Assets (%) | Distribution of NAIC Credit Designations (%) | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | 1A | 1B-1C-1D | 1E-1F-1G | 2 | 3 | 4 | 5 | 6 | None |
| **171** | 1,147 | 9,564 | 15,809 | 12 | 7 | 19 | 23 | 25 | 21 | 9 | 3 | 0 | 0 | - |
| **167** | 1,173 | 17,741 | 22,878 | 7 | 5 | 10 | 21 | 30 | 40 | - | - | - | - | - |
| **163** | 1,201 | 11,028 | 15,206 | 11 | 8 | 63 | 22 | 4 | 11 | 1 | - | - | - | - |
| **162** | 3,535 | 49,601 | 70,599 | 7 | 5 | 38 | 13 | 20 | 30 | 0 | - | - | - | - |
| **156** | 5,045 | 90,878 | 115,129 | 6 | 4 | 52 | 19 | 21 | 4 | 3 | 2 | - | - | - |
| **156** | 1,263 | 31,202 | 43,446 | 4 | 3 | 19 | 23 | 45 | 12 | 1 | - | - | - | - |
| **153** | 364 | 3,838 | 4,383 | 9 | 8 | 11 | 12 | 7 | 4 | 56 | 8 | 2 | - | - |
| **144** | 656 | 27,567 | 31,817 | 2 | 2 | 47 | 38 | 8 | 6 | 1 | 0 | - | - | - |
| **143** | 1,562 | 20,887 | 28,283 | 7 | 6 | 25 | 50 | 19 | 1 | 5 | 0 | - | - | - |
| **142** | 163 | 2,822 | 3,225 | 6 | 5 | 69 | 26 | 6 | - | - | - | - | - | - |
| **141** | 1,728 | 16,397 | 22,368 | 11 | 8 | 20 | 15 | 37 | 25 | 3 | 1 | - | - | - |
| **141** | 7,446 | 85,579 | 116,968 | 9 | 6 | 73 | 22 | 4 | 1 | 0 | - | - | - | - |
| **140** | 138 | 1,258 | 1,763 | 11 | 8 | 40 | 14 | 3 | 41 | 1 | 1 | - | - | - |
| **139** | 2,816 | 47,947 | 68,052 | 6 | 4 | 47 | 40 | 12 | 1 | - | - | - | - | - |
| **135** | 355 | 2,344 | 3,822 | 15 | 9 | 0 | 3 | 25 | 70 | 2 | - | - | - | - |
| **122** | 1,061 | 39,141 | 47,574 | 3 | 2 | 48 | 17 | 15 | 5 | 3 | 1 | - | 11 | - |
| **121** | 2,290 | 61,501 | 88,651 | 4 | 3 | 55 | 27 | 16 | 3 | - | 0 | - | - | - |
| **120** | 487 | 4,280 | 5,381 | 11 | 9 | - | 10 | 2 | 67 | 21 | - | - | - | - |
| **114** | 1,226 | 13,132 | 18,732 | 9 | 7 | 66 | 21 | 9 | 2 | 1 | 0 | - | - | - |
| **110** | 282 | 4,698 | 6,294 | 6 | 4 | 5 | 63 | 32 | - | - | - | - | - | - |
| **106** | 266 | 1,316 | 1,767 | 20 | 15 | - | 2 | 27 | 62 | 9 | - | - | - | - |
| **105** | 1,484 | 214,163 | 310,386 | 1 | 0 | 43 | 48 | 1 | 2 | 1 | 0 | 1 | 4 | - |
| **104** | 980 | 12,964 | 16,409 | 8 | 6 | 53 | 47 | - | - | - | 0 | - | 0 | - |
| **103** | 302 | 3,546 | 6,135 | 9 | 5 | 33 | 16 | 19 | 32 | 0 | 0 | - | - | - |
| **100** | 412 | 3,755 | 4,655 | 11 | 9 | 92 | 5 | 3 | - | - | - | - | - | - |
| **99** | 412 | 4,184 | 4,605 | 10 | 9 | 44 | 16 | 19 | 19 | 3 | - | - | - | - |
| **98** | 306 | 891 | 1,196 | 34 | 26 | 4 | 3 | 10 | 74 | 8 | - | - | - | - |
| **98** | 1,511 | 33,934 | 46,016 | 4 | 3 | 32 | 44 | 20 | 3 | 1 | - | - | - | - |
| **96** | 203 | 2,675 | 3,417 | 8 | 6 | 30 | 27 | 25 | 13 | 1 | 1 | 3 | - | - |
| **95** | 2,649 | 39,590 | 61,907 | 7 | 4 | 56 | 32 | 9 | 3 | - | - | - | - | - |
| **93** | 64 | 1,740 | 1,883 | 4 | 3 | 88 | 12 | - | - | - | - | - | - | - |
| **92** | 202 | 514 | 694 | 39 | 29 | 4 | 1 | 10 | 75 | 10 | - | - | - | 0 |
| **88** | 169 | 2,391 | 2,757 | 7 | 6 | - | 26 | 57 | 17 | - | - | - | - | - |
| **88** | 42 | 2,489 | 3,038 | 2 | 1 | 35 | 29 | 36 | - | - | - | - | - | - |
| **82** | 107 | 10,401 | 15,824 | 1 | 1 | 9 | 30 | 27 | 34 | - | - | - | - | - |

| # Unique CLO Deals | CLO Debt BV ($mn) | D1 BV ($mn) | Total Cash & Invested Assets ($mn) | CLO : D1 (%) | CLO : Total Assets (%) | Distribution of NAIC Credit Designations (%) | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | 1A | 1B-1C-1D | 1E-1F-1G | 2 | 3 | 4 | 5 | 6 | None |
| **77** | 320 | 7,259 | 8,930 | 4 | 4 | 32 | 23 | 28 | 17 | - | - | - | - | - |
| **76** | 385 | 3,842 | 5,960 | 10 | 6 | 47 | 45 | 4 | 4 | - | - | - | - | - |
| **76** | 215 | 4,085 | 4,806 | 5 | 4 | 10 | 49 | 22 | 18 | 1 | - | - | - | - |
| **75** | 118 | 519 | 874 | 23 | 13 | 2 | 7 | 9 | 82 | - | - | - | - | - |
| **72** | 97 | 1,173 | 1,431 | 8 | 7 | 1 | 29 | 52 | 19 | - | - | - | - | - |
| **69** | 900 | 34,726 | 54,106 | 3 | 2 | 47 | 26 | 16 | 11 | 1 | 0 | - | - | - |
| **68** | 152 | 9,910 | 15,657 | 2 | 1 | 73 | 18 | 6 | 3 | - | - | - | - | - |
| **67** | 911 | 53,004 | 79,856 | 2 | 1 | 37 | 63 | - | - | - | - | - | 0 | - |
| **64** | 60 | 2,314 | 3,732 | 3 | 2 | 25 | 13 | 30 | 18 | 14 | - | - | - | - |
| **63** | 37 | 1,431 | 1,658 | 3 | 2 | 38 | 29 | 33 | - | - | - | - | - | - |
| **59** | 88 | 872 | 1,225 | 10 | 7 | 17 | 67 | 10 | 6 | - | - | - | - | - |
| **59** | 497 | 6,130 | 7,498 | 8 | 7 | 16 | 39 | 28 | 11 | 6 | - | - | - | - |
| **57** | 75 | 479 | 492 | 16 | 15 | 14 | 57 | 29 | - | - | - | - | - | - |
| **56** | 199 | 3,517 | 4,952 | 6 | 4 | 47 | 40 | 5 | 8 | - | - | - | - | - |
| **54** | 168 | 15,178 | 22,996 | 1 | 1 | - | 59 | 40 | - | - | - | - | - | 0 |
| **53** | 116 | 7,733 | 10,780 | 1 | 1 | 17 | 19 | 11 | 52 | - | - | - | - | 1 |
| **50** | 162 | 877 | 1,059 | 18 | 15 | 22 | 17 | 3 | 58 | - | - | - | - | - |
| **48** | 77 | 2,836 | 3,205 | 3 | 2 | 1 | 4 | 31 | 64 | - | - | - | - | - |
| **47** | 227 | 13,478 | 17,197 | 2 | 1 | 41 | 46 | 13 | - | - | - | - | - | - |
| **46** | 646 | 25,349 | 30,881 | 3 | 2 | 62 | 38 | - | - | - | - | - | - | - |
| **46** | 477 | 54,120 | 79,176 | 1 | 1 | 46 | 18 | 20 | 3 | 9 | 3 | - | 1 | - |
| **45** | 108 | 879 | 1,099 | 12 | 10 | 19 | 78 | 3 | - | - | - | - | - | - |
| **44** | 337 | 8,598 | 11,955 | 4 | 3 | 61 | 31 | 8 | - | - | - | - | - | - |
| **43** | 362 | 3,453 | 10,205 | 10 | 4 | - | 11 | 29 | 61 | - | - | - | - | - |
| **42** | 51 | 955 | 1,201 | 5 | 4 | 38 | 36 | 16 | 6 | - | - | 2 | 2 | - |
| **42** | 161 | 3,076 | 3,776 | 5 | 4 | 8 | 3 | 50 | 38 | 2 | - | - | - | - |
| **42** | 258 | 42,688 | 56,816 | 1 | 0 | 34 | 47 | 16 | 3 | - | - | - | - | - |
| **40** | 146 | 5,219 | 6,440 | 3 | 2 | - | 36 | 19 | 25 | - | 14 | 2 | 5 | - |
| **38** | 137 | 2,567 | 3,435 | 5 | 4 | 58 | 40 | 1 | 1 | 1 | 0 | - | - | - |
| **37** | 164 | 874 | 1,026 | 19 | 16 | 45 | 34 | 18 | 2 | - | - | - | - | - |
| **37** | 362 | 8,226 | 10,315 | 4 | 4 | 80 | 16 | - | 3 | - | - | 0 | 0 | - |
| **36** | 479 | 9,720 | 14,917 | 5 | 3 | 16 | 47 | 31 | 3 | 2 | - | - | - | - |
| **36** | 21 | 735 | 872 | 3 | 2 | 40 | 20 | 20 | 19 | - | - | - | - | - |
| **35** | 128 | 1,472 | 1,808 | 9 | 7 | 1 | 0 | 3 | 10 | 81 | - | - | - | 4 |
| **33** | 258 | 3,628 | 3,873 | 7 | 7 | 12 | 79 | 3 | 4 | 3 | - | - | - | - |

| # Unique CLO Deals | CLO Debt BV ($mn) | D1 BV ($mn) | Total Cash & Invested Assets ($mn) | CLO : D1 (%) | CLO : Total Assets (%) | Distribution of NAIC Credit Designations (%) | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | 1A | 1B-1C-1D | 1E-1F-1G | 2 | 3 | 4 | 5 | 6 | None |
| **32** | 35 | 987 | 1,158 | 4 | 3 | 20 | 55 | 20 | 5 | - | - | - | - | - |
| **31** | 49 | 297 | 629 | 16 | 8 | 3 | 2 | 1 | 4 | 85 | 5 | - | - | - |
| **30** | 41 | 1,157 | 1,743 | 4 | 2 | 33 | 30 | 36 | - | - | - | - | - | - |
| **29** | 62 | 2,003 | 2,415 | 3 | 3 | 45 | 34 | 3 | 18 | - | - | - | - | - |
| **29** | 46 | 2,256 | 3,031 | 2 | 2 | 26 | 41 | 34 | - | - | - | - | - | - |
| **28** | 22 | 119 | 219 | 18 | 10 | 2 | 7 | 28 | 63 | - | - | - | - | - |
| **28** | 35 | 1,318 | 1,627 | 3 | 2 | 36 | 64 | - | - | - | - | - | - | - |
| **27** | 91 | 2,381 | 2,798 | 4 | 3 | 20 | 53 | 26 | - | - | - | - | - | - |
| **27** | 43 | 3,287 | 4,088 | 1 | 1 | 23 | 76 | 1 | - | - | - | - | - | - |
| **26** | 114 | 13,358 | 18,067 | 1 | 1 | 3 | 91 | 6 | - | - | - | - | - | - |
| **25** | 90 | 2,778 | 3,629 | 3 | 2 | 12 | 30 | 28 | 31 | - | - | - | - | - |
| **25** | 7 | 1,897 | 2,064 | 0 | 0 | 45 | 26 | 24 | 5 | - | - | - | - | - |
| **20** | 47 | 258 | 302 | 18 | 15 | - | - | 61 | 39 | - | - | - | - | - |
| **20** | 129 | 2,452 | 2,783 | 5 | 5 | 15 | 35 | 35 | 15 | - | - | - | - | - |
| **20** | 52 | 1,922 | 2,737 | 3 | 2 | 7 | 50 | 43 | - | - | - | - | - | - |
| **20** | 12 | 1,149 | 1,376 | 1 | 1 | 80 | 20 | - | - | - | - | - | - | - |
| **19** | 46 | 1,774 | 2,309 | 3 | 2 | 41 | 59 | - | - | - | - | - | - | - |
| **19** | 5 | 192 | 239 | 2 | 2 | 35 | 38 | 27 | - | - | - | - | - | - |
| **19** | 143 | 6,487 | 10,184 | 2 | 1 | 27 | 36 | 35 | 1 | - | - | - | - | 1 |
| **18** | 9 | 112 | 191 | 8 | 5 | 8 | 13 | 78 | - | - | - | - | - | - |
| **18** | 8 | 960 | 1,007 | 1 | 1 | 29 | 51 | 21 | - | - | - | - | - | - |
| **17** | 28 | 235 | 367 | 12 | 8 | - | 8 | 5 | 83 | 3 | - | - | - | - |
| **17** | 150 | 3,556 | 4,560 | 4 | 3 | 1 | 15 | 35 | 30 | 10 | 9 | - | - | - |
| **17** | 97 | 3,412 | 4,066 | 3 | 2 | 59 | 41 | - | - | - | - | - | - | - |
| **15** | 12 | 492 | 611 | 2 | 2 | 59 | 41 | - | - | - | - | - | - | - |
| **15** | 21 | 2,552 | 2,925 | 1 | 1 | 100 | - | - | - | - | - | - | - | - |
| **14** | 16 | 505 | 572 | 3 | 3 | 89 | 6 | 4 | - | - | - | - | - | - |
| **13** | 4 | 102 | 215 | 4 | 2 | 46 | 54 | - | - | - | - | - | - | - |
| **13** | 198 | 33,208 | 38,597 | 1 | 1 | 97 | 3 | - | - | - | - | - | - | - |
| **12** | 5 | 80 | 147 | 6 | 3 | 22 | 22 | 7 | 49 | - | - | - | - | - |
| **12** | 33 | 1,072 | 1,372 | 3 | 2 | 26 | 53 | 6 | 16 | - | - | - | - | - |
| **11** | 34 | 290 | 511 | 12 | 7 | - | - | 9 | 74 | 17 | - | - | - | - |
| **11** | 26 | 1,590 | 1,818 | 2 | 1 | 66 | 26 | 8 | - | - | - | - | - | - |
| **10** | 9 | 474 | 561 | 2 | 2 | 2 | 4 | - | 94 | - | - | - | - | - |
| **10** | 4 | 276 | 292 | 2 | 1 | 100 | - | - | - | - | - | - | - | - |

| # Unique CLO Deals | CLO Debt BV ($mn) | D1 BV ($mn) | Total Cash & Invested Assets ($mn) | CLO : D1 (%) | CLO : Total Assets (%) | Distribution of NAIC Credit Designations (%) | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | 1A | 1B-1C-1D | 1E-1F-1G | 2 | 3 | 4 | 5 | 6 | None |
| **9** | 10 | 80 | 119 | 12 | 8 | - | - | - | 100 | - | - | - | - | - |
| **9** | 50 | 609 | 662 | 8 | 8 | 84 | 16 | - | - | - | - | - | - | - |
| **9** | 38 | 1,517 | 1,728 | 2 | 2 | 17 | - | 63 | 20 | - | - | - | - | - |
| **9** | 28 | 1,159 | 1,217 | 2 | 2 | 19 | 81 | - | - | - | - | - | - | - |
| **8** | 2 | 68 | 78 | 2 | 2 | 100 | - | - | - | - | - | - | - | - |
| **7** | 7 | 233 | 391 | 3 | 2 | 100 | - | - | - | - | - | - | - | - |
| **7** | 3 | 112 | 140 | 2 | 2 | 60 | 20 | 20 | - | - | - | - | - | - |
| **7** | 18 | 1,028 | 1,060 | 2 | 2 | - | 100 | - | - | - | - | - | - | - |
| **7** | 5 | 365 | 496 | 1 | 1 | 71 | 29 | - | - | - | - | - | - | - |
| **7** | 6 | 425 | 458 | 1 | 1 | 10 | 90 | - | - | - | - | - | - | - |
| **7** | 8 | 828 | 940 | 1 | 1 | - | 100 | - | - | - | - | - | - | - |
| **7** | 2 | 467 | 566 | 0 | 0 | 21 | 32 | 47 | - | - | - | - | - | - |
| **6** | 3 | 163 | 252 | 2 | 1 | 34 | 66 | - | - | - | - | - | - | - |
| **6** | 2 | 122 | 124 | 1 | 1 | 100 | - | - | - | - | - | - | - | - |
| **6** | 2 | 185 | 223 | 1 | 1 | 46 | 27 | 27 | - | - | - | - | - | - |
| **6** | 4 | 479 | 582 | 1 | 1 | 60 | 17 | 23 | - | - | - | - | - | - |
| **6** | 16 | 7,725 | 9,869 | 0 | 0 | 100 | - | - | - | - | - | - | - | - |
| **5** | 5 | 25 | 55 | 19 | 9 | 100 | - | - | - | - | - | - | - | - |
| **5** | 5 | 176 | 202 | 3 | 3 | 36 | 64 | - | - | - | - | - | - | - |
| **5** | 5 | 313 | 367 | 2 | 1 | 100 | - | - | - | - | - | - | - | - |
| **5** | 3 | 218 | 264 | 2 | 1 | 82 | 18 | - | - | - | - | - | - | - |
| **5** | 2 | 178 | 210 | 1 | 1 | 58 | 21 | 21 | - | - | - | - | - | - |
| **4** | 4 | 196 | 219 | 2 | 2 | 100 | - | - | - | - | - | - | - | - |
| **4** | 2 | 142 | 149 | 1 | 1 | 26 | 24 | 25 | 25 | - | - | - | - | - |
| **4** | 3 | 307 | 599 | 1 | 0 | - | 16 | 84 | - | - | - | - | - | - |
| **4** | 2 | 216 | 271 | 1 | 1 | 69 | - | 31 | - | - | - | - | - | - |
| **4** | 1 | 148 | 171 | 1 | 1 | 52 | 48 | - | - | - | - | - | - | - |
| **4** | 2 | 1,093 | 1,249 | 0 | 0 | 100 | - | - | - | - | - | - | - | - |
| **4** | 93 | 62,590 | 112,713 | 0 | 0 | 100 | - | - | - | - | - | - | - | - |
| **3** | 4 | 22 | 22 | 19 | 18 | 100 | - | - | - | - | - | - | - | - |
| **3** | 2 | 102 | 110 | 1 | 1 | 50 | 50 | - | - | - | - | - | - | - |
| **3** | 1 | 141 | 179 | 1 | 0 | 38 | - | 62 | - | - | - | - | - | - |
| **3** | 1 | 9,987 | 20,760 | 0 | 0 | - | - | - | - | - | - | - | - | 100 |
| **2** | 0 | 20 | 29 | 1 | 1 | 50 | - | 50 | - | - | - | - | - | - |
| **1** | 2 | 33 | 38 | 6 | 5 | - | 100 | - | - | - | - | - | - | - |

| # Unique CLO Deals | CLO Debt BV ($mn) | D1 BV ($mn) | Total Cash & Invested Assets ($mn) | CLO : D1 (%) | CLO : Total Assets (%) | Distribution of NAIC Credit Designations (%) | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | 1A | 1B-1C-1D | 1E-1F-1G | 2 | 3 | 4 | 5 | 6 | None |
| **1** | 2 | 55 | 58 | 3 | 3 | - | 100 | - | - | - | - | - | - | - |
| **1** | 2 | 116 | 184 | 1 | 1 | - | 100 | - | - | - | - | - | - | - |
| **1** | 24 | 2,022 | 2,555 | 1 | 1 | 56 | 15 | - | 11 | - | - | - | - | 18 |
| **1** | 1 | 147 | 180 | 1 | 1 | - | - | 51 | 49 | - | - | - | - | - |
| **1** | 0 | 3 | 30 | 1 | 0 | - | - | - | - | - | - | - | 100 | - |
| **1** | 0 | 8 | 12 | 1 | 0 | 100 | - | - | - | - | - | - | - | - |
| **1** | 8 | 1,539 | 2,364 | 0 | 0 | - | - | 92 | 8 | - | - | - | - | - |
| **1** | 1 | 114 | 123 | 0 | 0 | 100 | - | - | - | - | - | - | - | - |
| **1** | 2 | 414 | 448 | 0 | 0 | - | - | 100 | - | - | - | - | - | - |
| **1** | 1 | 209 | 344 | 0 | 0 | 100 | - | - | - | - | - | - | - | - |
| **1** | 1 | 177 | 195 | 0 | 0 | - | - | 100 | - | - | - | - | - | - |
| **1** | 0 | 217 | 253 | 0 | 0 | - | 100 | - | - | - | - | - | - | - |
| **1** | 0 | 35 | 94 | 0 | 0 | 100 | - | - | - | - | - | - | - | - |
| **1** | 0 | 91 | 93 | 0 | 0 | 100 | - | - | - | - | - | - | - | - |
| **1** | 0 | 449 | 503 | 0 | 0 | - | 100 | - | - | - | - | - | - | - |
| **1** | 1 | 887 | 1,171 | 0 | 0 | - | 100 | - | - | - | - | - | - | - |
| **1** | 1 | 1,542 | 1,712 | 0 | 0 | - | - | - | - | - | - | 100 | - | - |
| **1** | 1 | 1,108 | 1,394 | 0 | 0 | - | 100 | - | - | - | - | - | - | - |
| **1** | 0 | 618 | 723 | 0 | 0 | 100 | - | - | - | - | - | - | - | - |

# Appendix O CDOnet Assumptions

| Field Name | Description | Commentary | Decision |
|---|---|---|---|
| Optional Redemption | Optional redemption assumptions | When a CLO has a low balance and expenses from the admin, trustee, etc., it may make sense to close the CLO. | Not modeled |
| Interest on Cash | Interest rate earned on cash | Money market rate/risk free rate; SOFR - 50/75 because SOFR tends to be higher than money market | SOFR minus 75 bps |
| Intra-Period Reinvestment | Reinvestment of proceeds within the period. Reinvested assets start accruing interest immediately (if reinvestment rate is set) | Reinvested assets start accruing interest immediately (if a reinvestment rate is set). The model adjusts both principal and accrued interest based on intra-period reinvestments, tracks interest accrual within the period and includes it in the interest income available for the next payment date. | All par reinvested before payment date |
| Already Defaulted Severity (%) | % loss on assets already defaulted | Assigns different severity to current defaulted population and future defaults | Match rates on all other collateral |
| Recovery Lag | Time lag of the recovery from defaulted loan | Recovery occurs immediately | Recovery occurs immediately |
| Monthly Rate during Initial Recov Lag | Monthly recovery rate | The rate at which recovery cash flows are received each month during the lag period immediately after a loan defaults. Most CLO models assume this is 0%, meaning recoveries start only after a full lag. Adjusting it upward assumes partial early recoveries, which shortens the cash flow impact of a default. | 0% |
| Prepay | Conditional prepayment rate | Most CLOs experience 5–15% annual prepayment rates in normal environments; NAIC assumes 0% rate | 0% |
| Rate Modification | Interest rate modification on the collateral loan | Set at individual loan level: 50 bps means a loan currently earning SOFR + 400 will be modeled at SOFR + 350; this will impact excess spread and IC test | Not modeled |
| Balance Forgiveness Rate | Percentage of a loan's outstanding principal balance that is written off (forgiven) in a restructuring or modification scenario. | If set to 0%, no loans are in forgiveness | Not modeled |
| Forbearance Rate | Percentage of the scheduled interest (and/or principal) payments that are not received during a forbearance period, due to a temporary agreement between lender and borrower (forbearance rate) | If set to 0%, no loans are in forbearance | Not modeled |
| Forbearance Paydown | Rate at which forbearance loans are expected to pay down. | A value of 0% means no special paydown is assumed for those loans | Not modeled |
| Forbearance Recovery | Recovery rate of forbearance balance | 100% means no loss for the forbearance loans | Not modeled |
| Default Scenario Multiplier | Probability of default scaling factor | 100% means 1x of base case PD, i.e., no special adjustment | All factors set to 1.0 |
| Severity Scenario Multiplier | Loss-given-default scaling factor | 100% means 1x of base case scenario, i.e., no extra stress | All factors set to 1.0 |

| Field Name | Description | Commentary | Decision |
|---|---|---|---|
| Forbearance Scenario Multiplier | Scaling factor applied to the percentage of forbearance balance | Not applicable if 0% forbearance rate | All factors set to 1.0 |
| Balance Forgiveness Scenario Multiplier | Scaling factor applied to the percentage of forgiveness balance | Not applicable if 0% forgiveness rate | All factors set to 1.0 |
| Forbearance Recovery Scenario Multiplier | Scaling factor applied to the percentage of the recovery rate of forbearance balance | Not applicable if 0% forbearance rate | All factors set to 1.0 |
| Prepay Scenario Multiplier | Prepayment rate scaling factor | Not applicable if 0% prepayment rate | All factors set to 1.0 |
| Default Assumption | "Reinvestment vector" used to model new loans | When original collateral matures before the reinvestment period ends, the system will automatically assume reinvestment of principal proceeds, subject to constraints defined in the deal | Per-year default and recovery rates are derived from the collateral modeling results |
| Price Constraints | Minimum purchase price | Minimum prices (e.g., 90–95%) limit aggressive risk-taking | Not modeled |
| Market Price Adjustment | Market price adjustment | Adjustment to reflect actual purchase price; -2% indicates that assets are bought at 98 instead of 100 | 0% |
| Collateral Liquidation Price | Collateral liquidation price, % of par | Collateral Liquidation Price refers to the assumed recovery price (as % of par) for the collateral pool if the CLO enters an early liquidation scenario, such as: 1) An event of default; 2) A failure of a key test (OC, IC); 3) A deal wind-down triggered by equity holders or manager resignation | No early liquidation |

PENDING

ATTACHMENT F

# Update from the Academy on the Collateralized Loan Obligation (CLO) Risk-Based Capital (RBC) Modeling Refinement Project