C-1 Subcommittee Update on CLO C-1 Factors Modeling—Residual Tranches and Portfolio Adjustment Factors

May 6, 2026

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Chairperson, C-1 Subcommittee

American Academy of Actuaries

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Glossary

AEY: Allowable Earned Yield accounting methodology for residual tranches
PE: Practical Expedient accounting methodology for residual tranches
KDE: Kernel Density Estimation, an estimate of a random variable's probability density function
BV: Book Value, the value at which an asset is carried on a life insurer's statutory financials
FV: Face Value, representing par for CLO debt tranches and net asset value for residual tranches

Residual Tranches

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Summary of Findings—Residual Tranches

Since the April 10, 2026, meeting, the Academy implemented two model corrections to the calculated C-1 factors for residual tranches:

1) Accumulated deficiencies begin accruing interest at 12/31/24 projection start date, not at issuance date (*Increases C-1 factors under AEY)*
2) When book value = 0, any income earned accrues to statutory surplus on an after-tax basis *(Decreases C-1 factors under AEY and PE)*

The Academy's conclusions remain unchanged:

- Comparable attributes for residual tranche C-1 factors do not add significant precision; the Academy recommends using a simple average of C-1 factors
- **The Academy's analysis shows that the current post-tax factor of 35.55% is within the range of C-1 factors across residual tranche SAP accounting methods**

Estimating C-1 Under Practical Expedient Accounting

$$C1 = \frac{PV(Max\ Accumulated\ Deficiency)_{\ YE\ 2024}}{Book\ Value_{YE\ 2024}}$$

- Book Value (BV) $_{t+1}$ = BV_t – Interest $_t$ – Principal Distributions[1] $_t$
- Accumulated Deficiency $_t$ = min{0, (1+r_{accum})× Accumulated $Deficiency_{t-1}$ + Stat Net Income (NI) $_t$
  + (Realized BV $Loss_t$) - (Realized Balance Loss $_t$ × Tax Rate) + Δ DTA $_t$ }
  - NI_t = – Interest $_t$ × Tax Rate
  - Deferred Tax Asset (DTA) = (Total Balance $_t$ – BV_t) × Tax Rate
  - Since the change in (Balance – BV) equals paid Interest, then NI and ΔDTA perfectly offset
  - Assuming buy and hold, the only Realized Loss is at the end of the projection period, equal to remaining BV or Balance
  - Accumulated Deficiency $_0$ = 0
- When the loss is realized, the tax rate times the outstanding *balance* is counted as a tax recovery, which eliminates the DTA balance

[1] A Principal Contribution is a negative Principal Distribution

Estimating C-1 Under Allowable Earned Yield

$$C1 = \frac{PV(Max\ Accumulated\ Deficiency)_{\ YE\ 2024}}{Book\ Value_{YE\ 2024}}$$

- Allowable Earned Yield (AEY) = residual tranche IRR over run-off period
- $BV_{t+1} = BV_t - \max\{0, Interest_t - Max\ AEY_t + Cumulative\ Shortfall_t\} - Principal\ Distributions^1{}_t$
  - $Max\ AEY_t = AEY_t \times BV_{t-1}$
  - $Cumulative\ Shortfall_t = \min\{0, Interest_t - Max\ AEY_t + Cumulative\ Shortfall_{t-1}\}$
- $Accumulated\ Deficiency_t = \min\{0, (1+r_{accum}) \times Accumulated\ Deficiency_{t-1} + NI_t + (Realized\ Book\ Value\ Loss_t) - (Realized\ Balance\ Loss_t \times Tax\ Rate) + \Delta\ DTA_t\}$
  - $NI_t = \min(Interest_t, Max\ AEY_t) + \max(\Delta\ Cumulative\ Shortfall_t, 0) - Interest_t \times Tax\ Rate$
  - $DTA_t = (Total\ Balance_t{}^2 - BV_t) \times Tax\ Rate$
  - $Accumulated\ Deficiency_0 = 0$
- When the loss is realized, the tax rate times the outstanding *balance* is counted as a tax recovery, which eliminates the DTA balance

[1] A Principal Contribution is a negative Principal Distribution

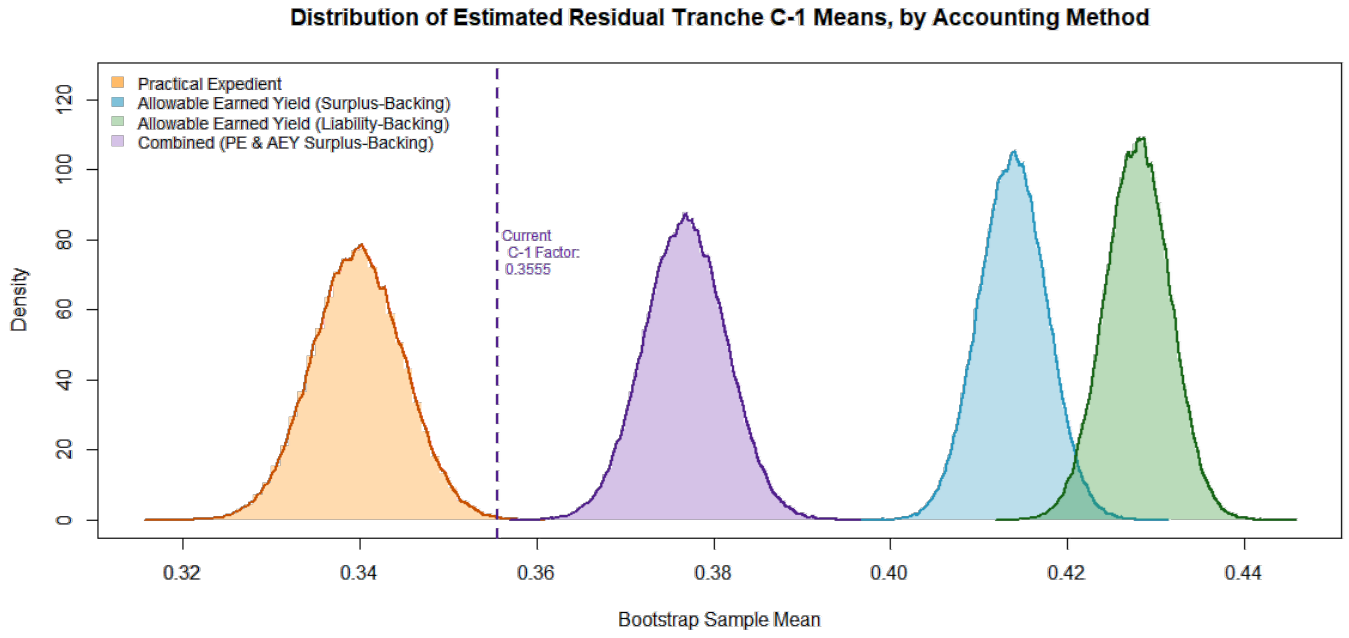
[2] Total Balance = Original Balance + Principal Contributions and Distributions

Liability- vs. Surplus-Backing Assumption

Liability-Backing	Surplus-Backing
• Statutory income is used to fulfill liability cashflows • When a loss occurs, the insurer uses its capital to absorb it • Typically leads to higher C-1 factors	• Statutory income is retained in surplus and earns interest • When a loss occurs, the insurer uses the accumulated statutory income first then its own capital to absorb it • Typically leads to lower C-1 factors

- Accumulated deficiencies under AEY are sensitive to the assumption of whether the residual tranches are liability- or surplus-backing, but not under Practical Expedient (PE)
- The results presented assume residual tranches are surplus-backing

Sample Means of C-1 Factors



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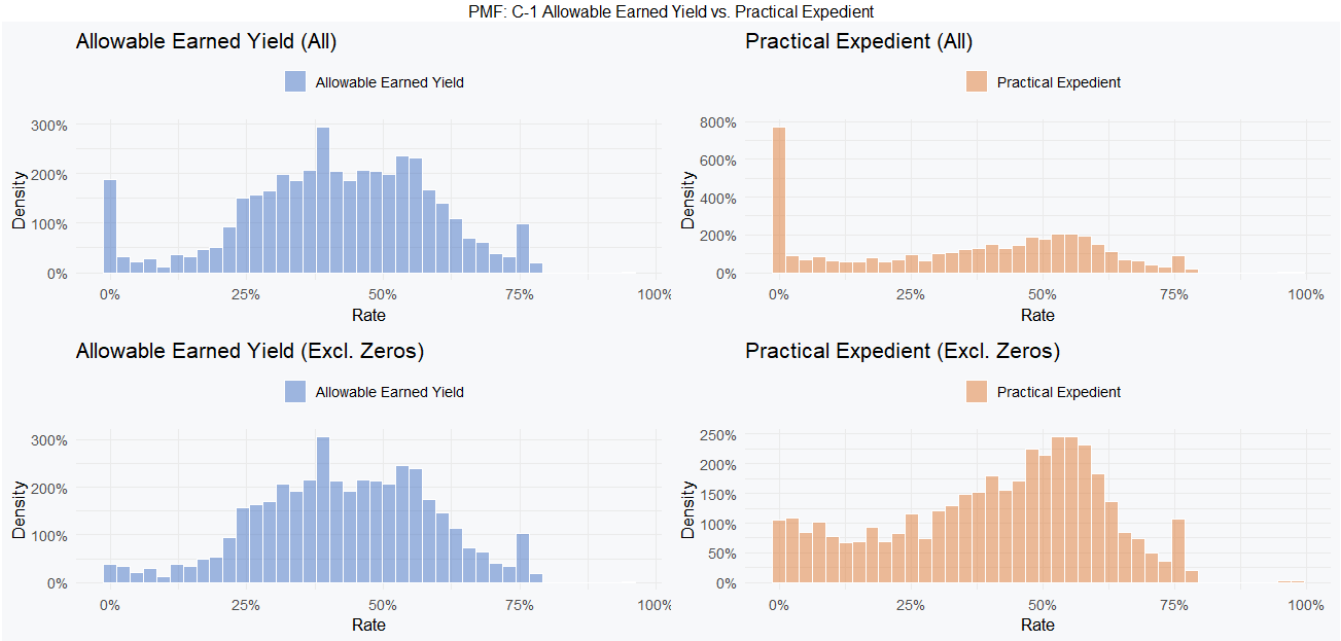
Distribution of Raw C-1 Factors



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Initial Comparable Attributes Results

- The Academy regresses Raw C-1 against potential comparable attributes
- The std dev of C-1 is 23.5% while the std dev of model residuals is 16.4%

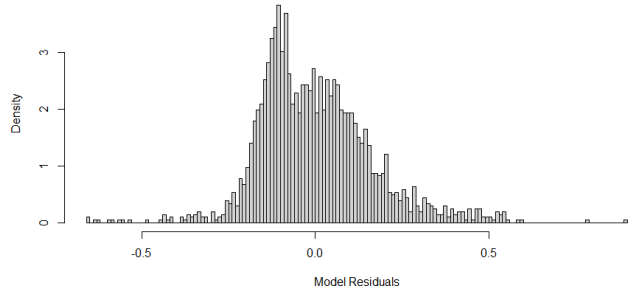
Regression Results

```
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 ***
int_prin_to_face -5.466e-01  1.180e-02 -46.320  < 2e-16 ***
WARF              7.511e-05  8.925e-06   8.415  < 2e-16 ***
TR_DP            -8.333e-01  1.191e-01  -7.000 3.46e-12 ***
max_rating_num    9.674e-03  2.058e-03   4.701 2.76e-06 ***
---
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
```

Comparable Attributes Considered

- TR_DP: Tranche Detachment Point
- WARF: Weighted average rating factor
- max_rating_num: Deal’s worst debt rating (where Aaa=1, Aa1=2, etc.)
- int_prin_to_face: Ratio of the sum of interest and net principal paid to model start-date, as a proportion of original face value (capped at 0 and 1)

Model Residuals



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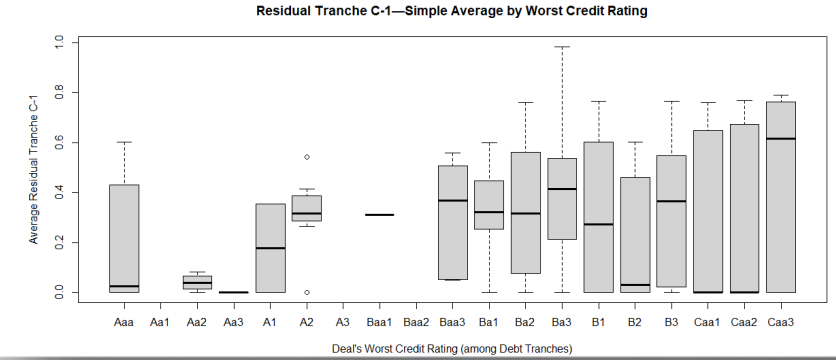
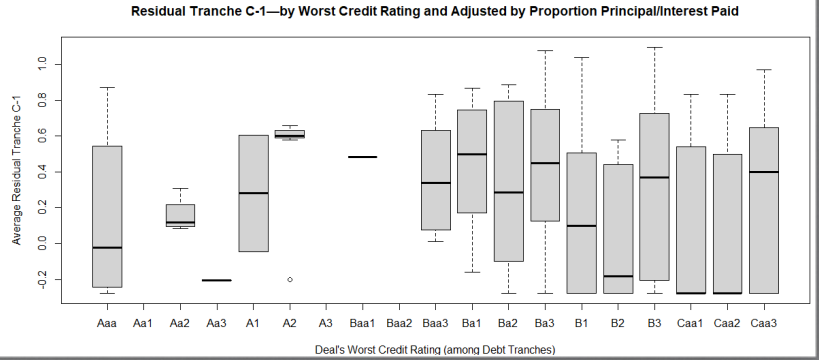
*Modeled C-1 Factors shown under Practical Expedient method

Limitations of Worst Credit Rating

- While a lower worst credit rating does *on average* indicate a greater C-1, there is no monotonicity across ratings; Ba3 has the highest median C-1 (except Caa3)
- When adjusting for the proportion of principal and interest already paid (assuming the mean value), the same problem persists
- The wide inter-quartile ranges (IQRs) indicate potential credibility issues with the data





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Alternative Comparable Attributes Results

- To address the issue of credibility, the Academy considered the proportion of balance within "low quality" debt CLO tranches (defined by different cutoff points)
  - The different cutoff points considered are: Baa1, Ba1, B1 and Caa1
- When adding these variables, max_rating_number becomes less statistically significant
- Condensing the credit covariates to just Ba1 / below retains roughly the same level of explanatory power

Regression Results

```
Residuals:
     Min       1Q   Median       3Q      Max
-0.65135 -0.10772 -0.01554  0.09166  0.89091

Coefficients:
                   Estimate Std. Error t value Pr(>|t|)
(Intercept)        0.521259   0.028137  18.526  < 2e-16 ***
int_prin_to_face  -0.551976   0.011878 -46.472  < 2e-16 ***
max_rating_num     0.005093   0.002131   2.390  0.01692 *
prop_Baa1_or_worse -0.011413   0.166946  -0.068  0.94550
prop_Ba1_or_worse  1.078025   0.250951   4.296 1.82e-05 ***
prop_B1_or_worse   0.538916   0.188661   2.857  0.00433 **
prop_Caa1_or_worse -0.533315   0.190012  -2.807  0.00505 **
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Residual standard error: 0.1616 on 2058 degrees of freedom
Multiple R-squared:  0.5288,    Adjusted R-squared:  0.5274
F-statistic: 384.9 on 6 and 2058 DF,  p-value: < 2.2e-16
```

Regression Results

```
Residuals:
     Min       1Q   Median       3Q      Max
-0.65121 -0.10922 -0.01788  0.09184  0.88010

Coefficients:
                  Estimate Std. Error t value Pr(>|t|)
(Intercept)       0.578114   0.007294   79.26   <2e-16 ***
int_prin_to_face -0.545435   0.011453  -47.62   <2e-16 ***
prop_Ba1_or_worse 1.335676   0.090402   14.78   <2e-16 ***
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Residual standard error: 0.1622 on 2062 degrees of freedom
Multiple R-squared:  0.5242,    Adjusted R-squared:  0.5238
F-statistic:  1136 on 2 and 2062 DF,  p-value: < 2.2e-16
```

Considering WARF and Detachment Point

- WARF is not statistically significant when the proportion of Ba1/below balance is considered (collateral credit is captured by CLO credit)
- Detachment point is statistically significant, but removing it from the model only slightly reduces R^2 from 52.9% to 52.4%
- The ratio of total interest and principal paid to current face value is the most explanatory variable; removing all other covariates reduces the R^2 from 52.9% to only 47.4%

```
Residuals:
     Min       1Q   Median       3Q      Max
-0.66481 -0.11001 -0.01731  0.09306  0.88431

Coefficients:
                    Estimate Std. Error t value Pr(>|t|)
(Intercept)         5.932e-01  2.667e-02  22.241  < 2e-16 ***
int_prin_to_face   -5.555e-01  1.166e-02 -47.624  < 2e-16 ***
WARF                1.483e-05  1.132e-05   1.310     0.19
TR_DP              -5.798e-01  1.187e-01  -4.885 1.11e-06 ***
prop_Ba1_or_worse   1.146e+00  1.215e-01   9.430  < 2e-16 ***
---
Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1

Residual standard error: 0.1613 on 2060 degrees of freedom
Multiple R-squared:  0.5299,    Adjusted R-squared:  0.529
F-statistic: 580.6 on 4 and 2060 DF,  p-value: < 2.2e-16
```

```
Residuals:
     Min       1Q   Median       3Q      Max
-0.65121 -0.10922 -0.01788  0.09184  0.88010

Coefficients:
                   Estimate Std. Error t value Pr(>|t|)
(Intercept)        0.578114   0.007294   79.26   <2e-16 ***
int_prin_to_face  -0.545435   0.011453  -47.62   <2e-16 ***
prop_Ba1_or_worse  1.335676   0.090402   14.78   <2e-16 ***
---
Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1

Residual standard error: 0.1622 on 2062 degrees of freedom
Multiple R-squared:  0.5242,    Adjusted R-squared:  0.5238
F-statistic:  1136 on 2 and 2062 DF,  p-value: < 2.2e-16
```

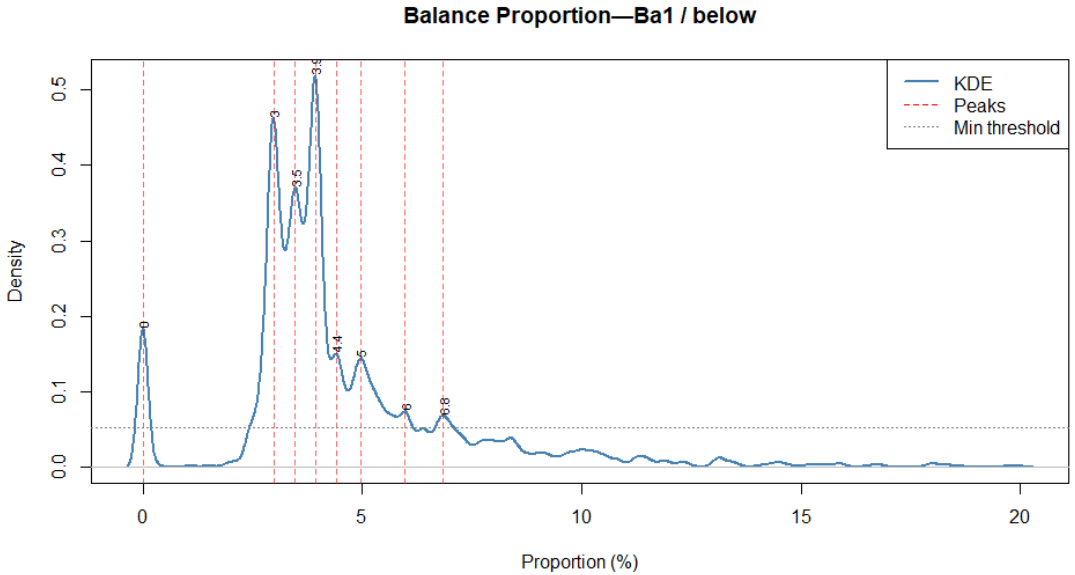
```
Residuals:
     Min       1Q   Median       3Q      Max
-0.61412 -0.12794 -0.02465  0.08551  0.85010

Coefficients:
                   Estimate Std. Error t value Pr(>|t|)
(Intercept)        0.614118   0.007228   84.96   <2e-16 ***
int_prin_to_face  -0.486175   0.011279  -43.10   <2e-16 ***
---
Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1

Residual standard error: 0.1705 on 2063 degrees of freedom
Multiple R-squared:  0.4739,    Adjusted R-squared:  0.4736
F-statistic:  1858 on 1 and 2063 DF,  p-value: < 2.2e-16
```

Distribution of Ba1 / Below Credit

- Balance in Ba1 or below credit averages 4.53% of total deal balance
- Proportions are clustered around 0%, 3% and 3.9%
- 87% of deals have less than 7% of balance in Ba1 or below credit



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*Modeled C-1 Factors shown under Practical Expedient method

Considerations for Additional Comparable Attributes

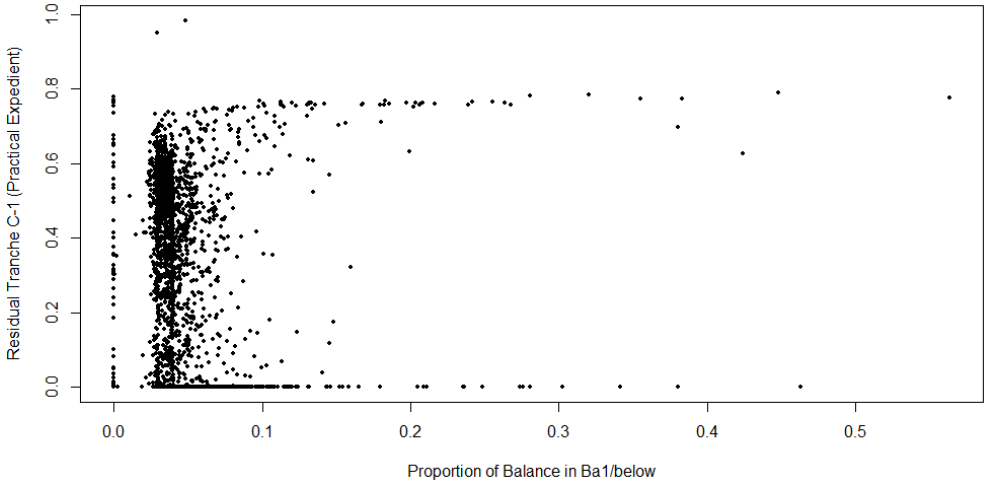
- Assuming the range of 0% – 7% for the proportion of Ba1 / below (debt credit quality, by balance), the implied C-1 factors range from 27.12% to 36.47%

- Because
  1) This <10% range of modeled factors is small compared to the wide dispersion of residual tranche C-1
  2) The relationship between debt credit and C-1 is not visually apparent

the Academy concludes that the explanatory power of debt credit quality does not warrant the operational complexity of adding a new attribute; a simple average factor is sufficient

Considered Formula:

$$27.12\% + 1.34 \times Proportion\ of\ Ba1/below$$



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Portfolio Adjustment Factors

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Summary of Findings—Portfolio Adjustment Factors

- The Academy models PAF consistent with the bond PAF methodology based on the number of unique loan *issuers* for a given portfolio of *N* CLO deals, deriving two metrics:
  - Absolute PAF = Portfolio of *N* CLO Deals PAF
  - Relative PAF = Absolute PAF ÷ Collateral Loan Universe PAF,
    assumes full diversification when holding a loan for every one of the 2,462 issuers in the collateral universe
- The Academy proposes two options:

Option 1	Option 2			
	N	CLO PAF	N	CLO PAF
CLO PAF of 1.00	1	1.38	7	1.08
	2	1.22	8	1.07
	3	1.16	9	1.07
	4	1.12	10	1.06
	5	1.10	11+	1.00
	6	1.09		
Based on Absolute PAF	Based on Relative PAF			

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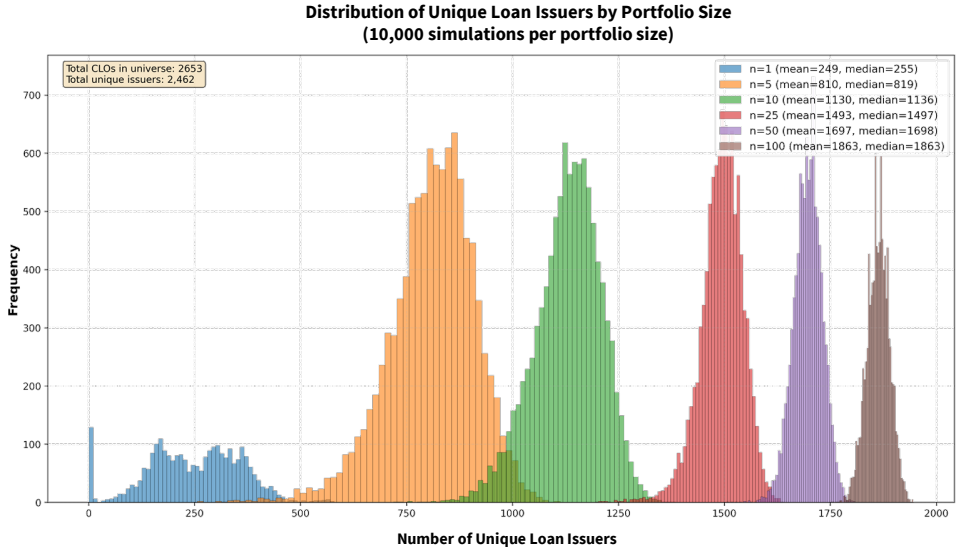
Loan Issuer Diversification by CLO Portfolio Size

- The average number of unique issuers in the collateral universe is 277 per CLO deal
- Here, CLO diversification is measured based on the number of unique loan issuers in the underlying collateral pool



N	1	250	500	750	1,000	1,250	1,500	1,750	2,000	2,250	2,500
Bond PAF	2.400	1.296	1.073	0.989	0.947	0.921	0.904	0.892	0.883	0.876	0.871

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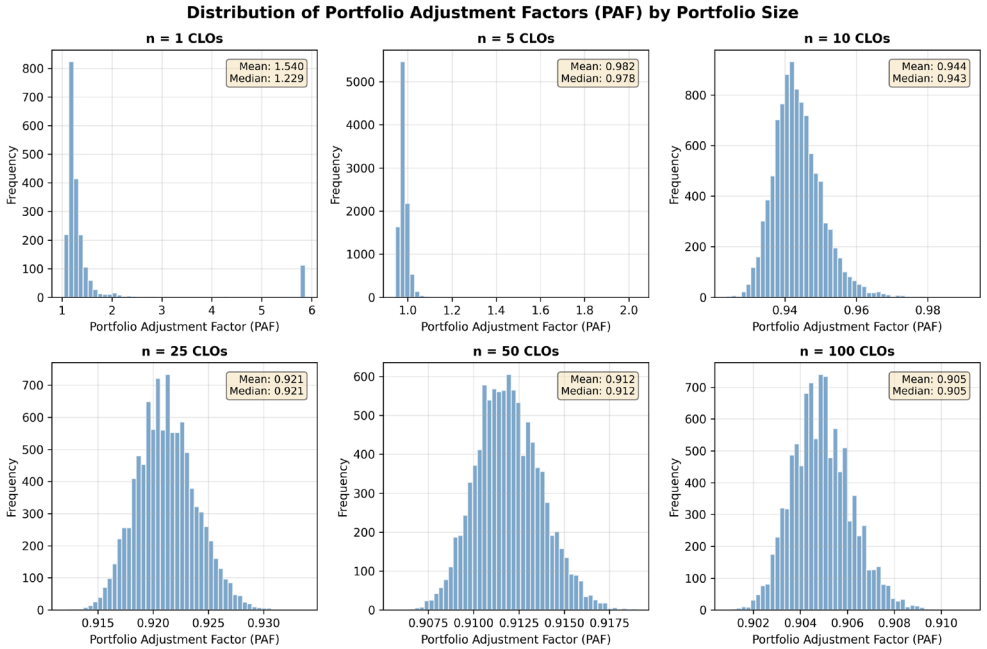
Absolute CLO Portfolio Adjustment Factor

- CLO Collateral and Bond Factor default risk is modeled at the issuer-level
- We apply the Bond PAF methodology to estimate *absolute* PAF for simulated portfolios of N randomly drawn CLO deals



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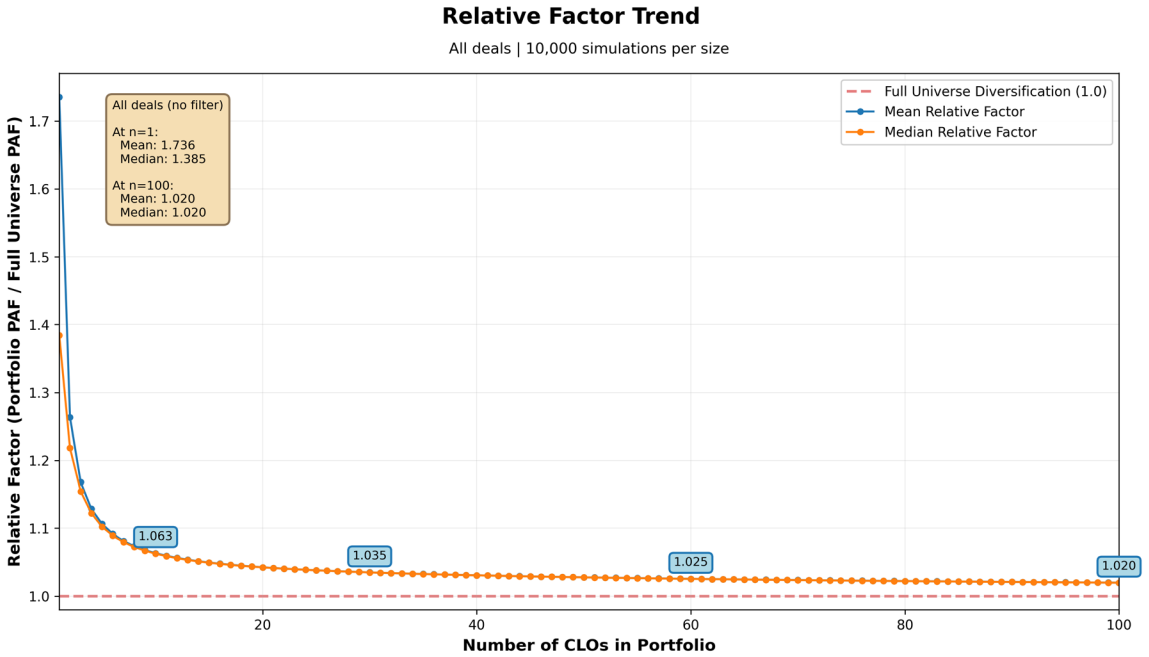
Relative CLO Portfolio Adjustment Factors

- PAF is calculated consistent with the bond PAF methodology assuming portfolios of N randomly drawn CLO deals
- We observe *relative* PAF quickly converges to 1.0 as the number of unique CLO deals in the portfolio increases



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*Based on YE2024 U.S. Statutory Filings

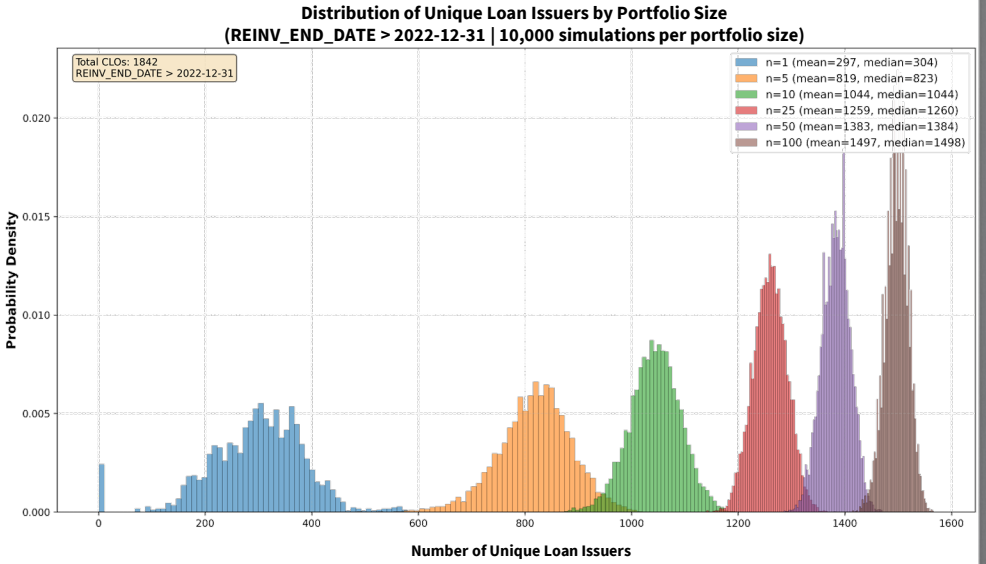
Absolute vs. Relative PAF for < 10 CLO Holdings

# Unique CLO Deals	Number of Companies*	Median Unique Loan Issuers	Median Absolute PAF	Median Relative PAF
1	18	294	1.2289	1.3848
2	2	482	1.0811	1.2182
3	6	618	1.0245	1.1545
4	6	719	0.9958	1.1221
5	6	800	0.9780	1.1020
6	6	863	0.9665	1.0890
7	3	914	0.9583	1.0798
8	3	959	0.9518	1.0725
9	5	995	0.9470	1.0671
10	0	1,028	0.9430	1.0625

Loan Issuer Diversification by CLO Portfolio Size

The Academy does not observe meaningful differences in relative PAF or loan issuer diversification when limiting the universe to "newer" CLO deals (reinvestment end date > 2022-12-31)

Metric	All	Newer CLOs
Unique CLO Deals	2,053	1,842
Unique Loan Issuers	1,874	1,864
N=1 Mean Relative PAF	1.736	1.526
N=10 Mean Relative PAF	1.063	1.060
N=100 Mean Relative PAF	1.020	1.019



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Life Insurance Industry CLO Holdings

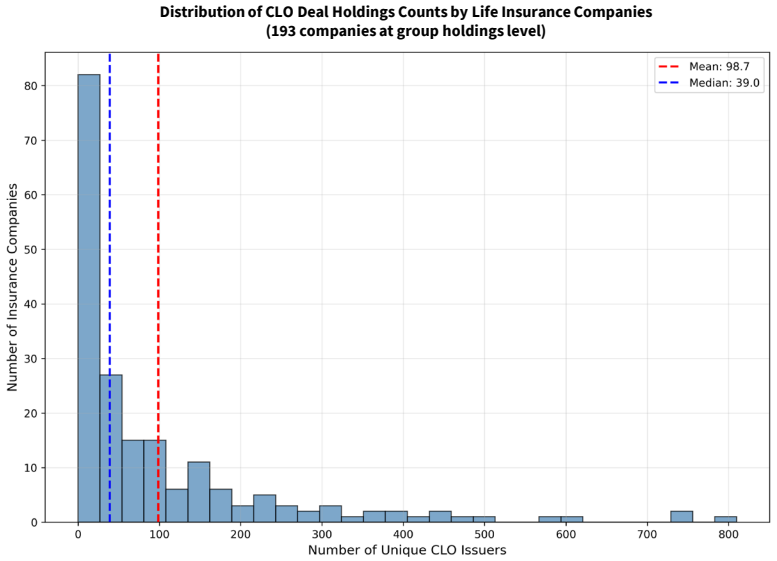
The life insurance industry holds concentrated CLO portfolios, with half of the companies holding fewer than 40 unique CLO deals

Key Statistics

Total CLO Holdings:	27,930
Unique CLO Deals:	3,307
Median CLO holdings per co.:	51
Median unique CLO deals per co.:	39
Standard deviation:	145.8
Range:	1 to 810 issuers
Q1 (25th percentile):	7 unique CLO deals
Q3 (75th percentile):	134 unique CLO deals

Distribution by Issuer Count

Unique CLO deals count range	# of Companies
1-10	57
11-25	24
26-50	27
51-100	27
101-200	28
201-500	25
501+	5



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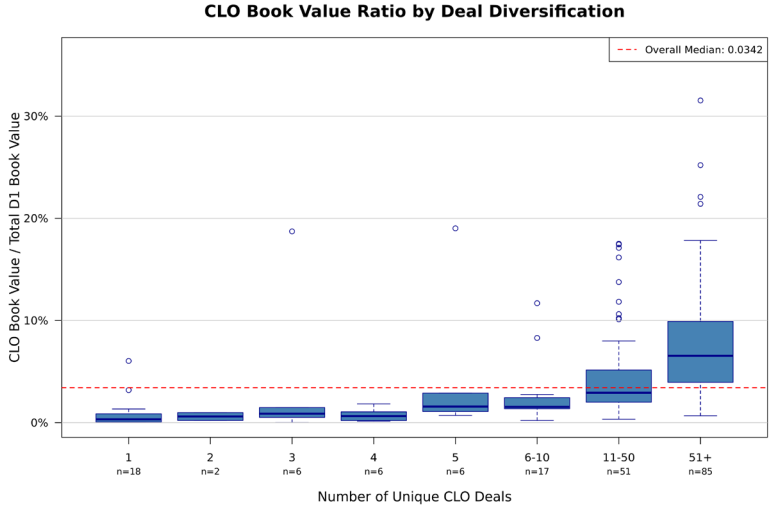
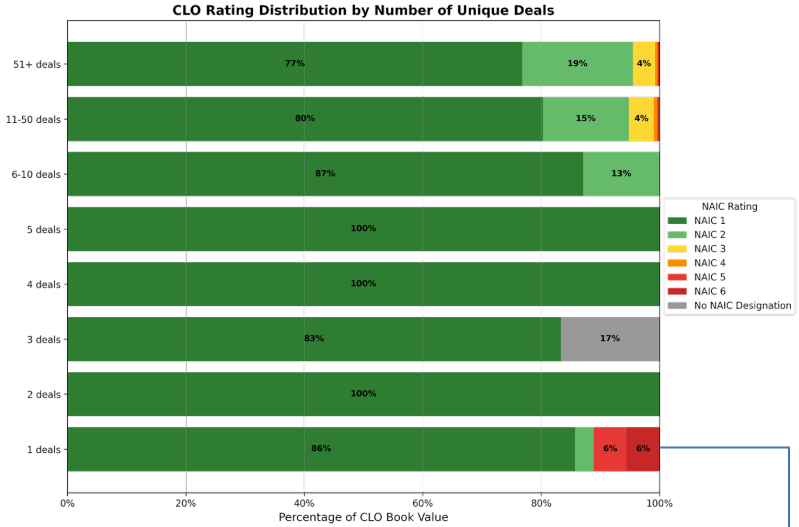
Life Insurance Industry CLO Holdings

Life insurers with fewer unique CLO deals generally allocate to higher quality tranches and have a smaller proportion of D1 assets allocated to CLOs





There are only 2 companies that hold 1 CLO below-investment grade debt tranche. The total BV of these CLO debt holdings represent less than 0.1% of total general account invested assets.

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Appendix—Supplemental Analysis

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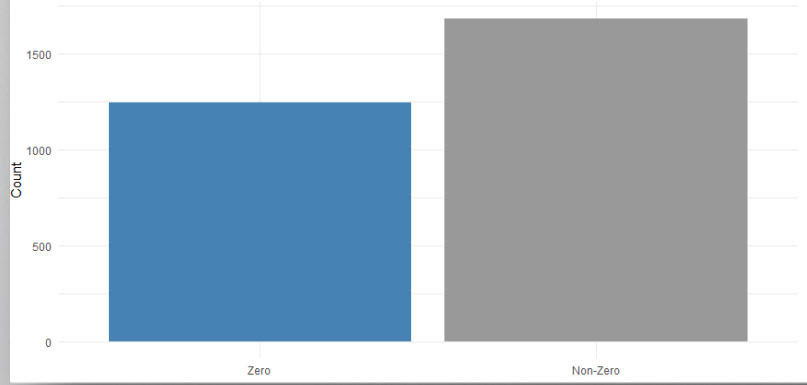
Embedded Model Conservatism

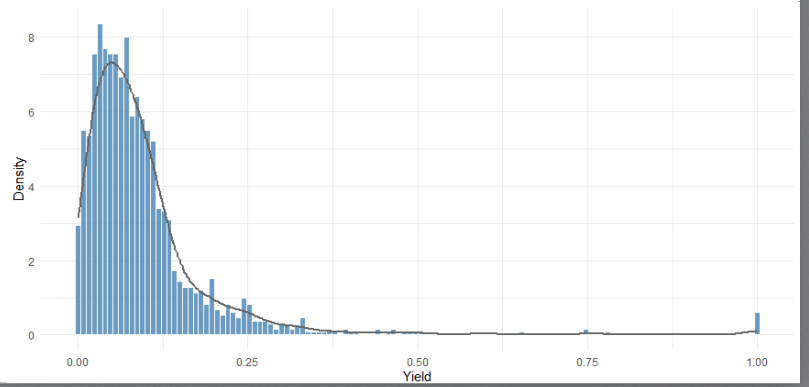
- CLO managers target >15% yields in the residual tranche
- The Academy's "Mean Loss Scenario" (assuming average levels of losses) produces an average yield of only 5.42%; a 15% yield is in the 92nd percentile
- This suggests that the collateral loss distribution assumptions are conservative and may overstate losses

Description	Value	Description	Value
Proportion of Yields = 0	42.55%	Mean Yield	5.42%
Mean Non-Zero Yield	9.43%	25th percentile of Non-Zero Yields	3.79%
Std of Non-Zero Yields	10.37%	50th percentile of Non-Zero Yields	7.06%
		75th percentile of Non-Zero Yields	11.28%

Residual Tranche Yields under Mean Loss Scenario—Zero vs. Non-Zero



Distribution of Non-Zero Residual Tranche Yields under Mean Loss Scenario



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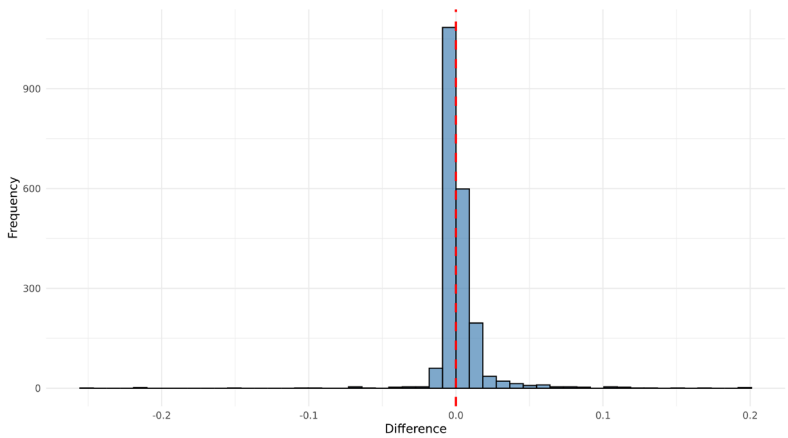
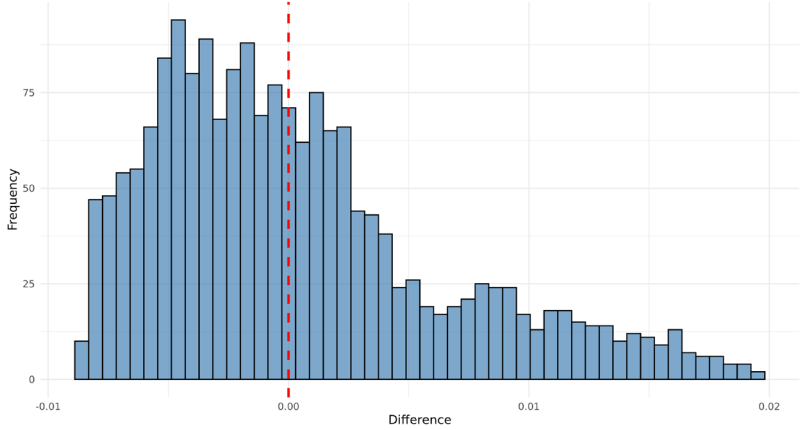
Collateral Bond RBC vs. Collateral PV Loss CTE90

- The Academy calculates the bond RBC for each loan and averages by CLO deal
- The Academy also estimates CTE90 of the present value of collateral losses
- Collateral RBC minus PV Loss CTE90 (“Difference” below) averages 0.18% with a median of -0.09%





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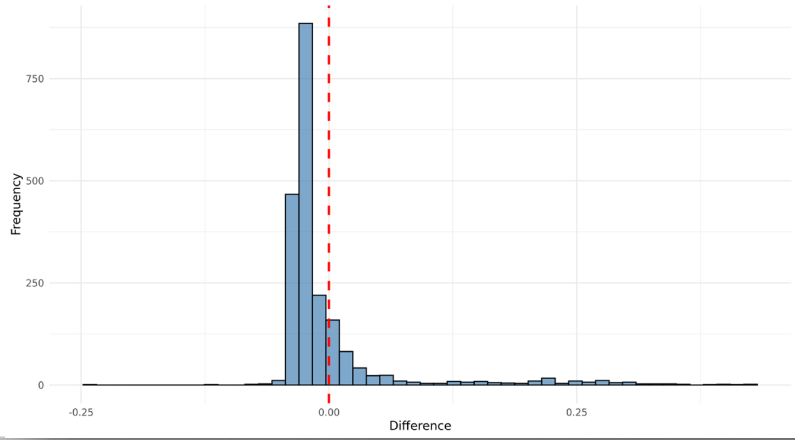
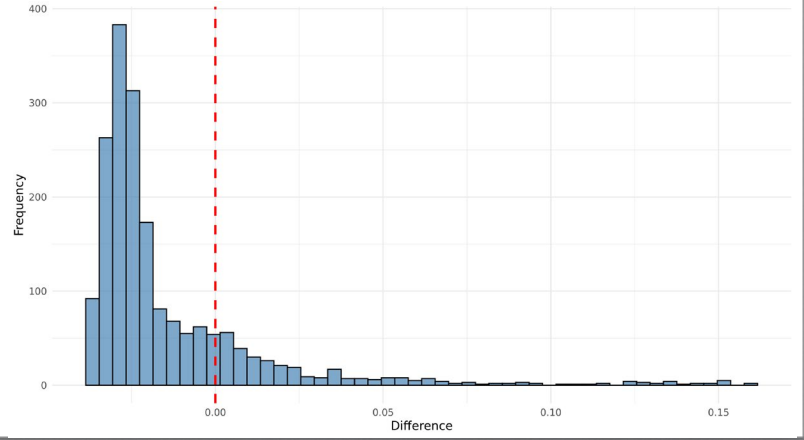
Collateral PV Loss CTE90 vs. Proposed CLO RBC Vertical Slide 29

- The Academy estimates the CLO RBC by applying proposed CLO tranche factors and averaging to the deal level; tranches are averaged by **face value** to neutralize the discrepancy introduced by residual tranche accounting
- Collateral PV Loss CTE90 minus Proposed CLO RBC ("Difference" below) averages -0.18% with a median of -2.44%





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Example CLO Deal at Median Collateral Loss

Statistics for Specific Deal at Median Loss	
Collateral CTE90 Loss PV (% of FV)	7.47%
Collateral RBC (Current Bond Factors[1])	7.72%
Post-Tax VaR96 Loss PV (% of FV)	7.13%
Post-Tax VaR96 BV Loss PV (% of BV)	2.23%
Vertical Slice CLO RBC (Proposed)	2.34%
Vertical Slice CLO RBC (Current Bond Factors[1])	1.31%

- The median collateral post-tax loss[2] PV is 7.47% across all CLO deals
- On this specific median deal, the 7.47% CTE90 collateral loss equates to $48mn (collateral RBC[2] is 7.72%), or $66mn pre-tax without discounting
- Under practical expedient accounting, the residual tranche's $52mn book value ("BV") has fallen to $0 due to (a) $38mn of prior payments received and (b) $14mn projected payments
- Under the VaR 96 scenario, we observe a $74mn undiscounted loss: (a) the **$52mn** residual tranche face value ("FV") falls to $0 and (b) an additional **$22mn of loss** penetrates the Ba3 tranche
- Residual tranche accounting reduces losses by **~2/3**, from **$46mn to $14mn**

Illustrative Numbers from VaR 96 for Specific Deal at Median Loss

Tranche Rating	DP (%)	Thickness (%)	FV ($mn)	BV ($mn)	Pre-Tax Loss Undisc. ($)	Post-Tax Loss PV ($)	Post-Tax Loss PV (% FV)	BV PV Loss ($)	Post-Tax BV PV Loss (% BV)
			A	B	C	D	D ÷ A	E	E ÷ B
Aaa	100.0	63.8	410	410	0	0	0.00	0	0.00
Aa2	36.2	12.2	78	78	0	0	0.00	0	0.00
A2	24.0	7.1	46	46	0	0	0.00	0	0.00
Baa3	17.0	6.1	39	39	0	0	0.00	0	0.00
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	0.00
Total			**649**	**610**	**74**	**46**	**7.13**	**14**	**2.23**

1. Bond factor model is calibrated to the VaR96 PV of losses
2. Collateral loss PV understates total loss because it does *not* include losses on reinvested assets; it underestimates RBC because RBC includes the risk premium provision

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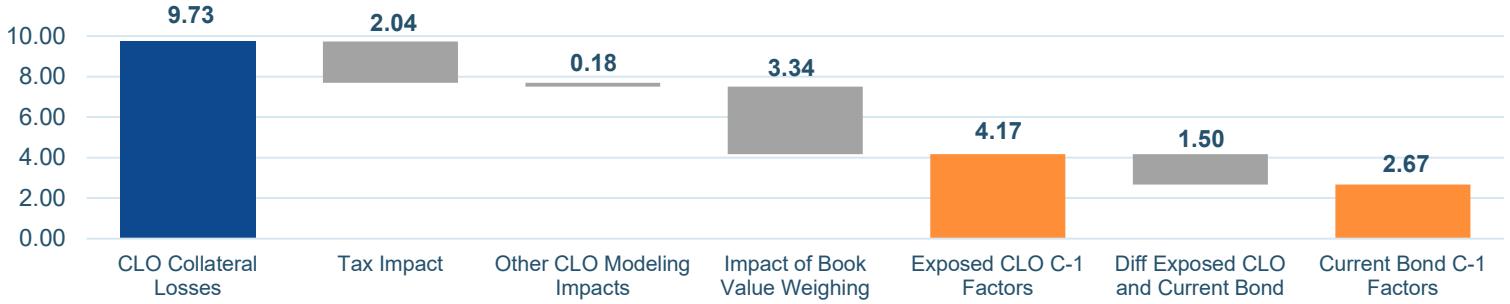
Collateral Losses vs. Exposed C-1 Factors

Tax adjustments and residual tranche BV accounting explain the difference between Exposed CLO C-1 factors and the collateral losses modeled



Equal-weighted averages across the CLO deal universe are shown for:

a) CLO Collateral Losses = PV of Pre-Tax Losses / Loan Balance as of 12/31/24 for CTE90 scenario
b) Exposed CLO C-1 Factors = BV-weighted Exposed CLO C-1 Factors for a vertical slice
c) Current C-1 Bond Factors = BV-weighted Current Bond C-1 Factors for a vertical slice

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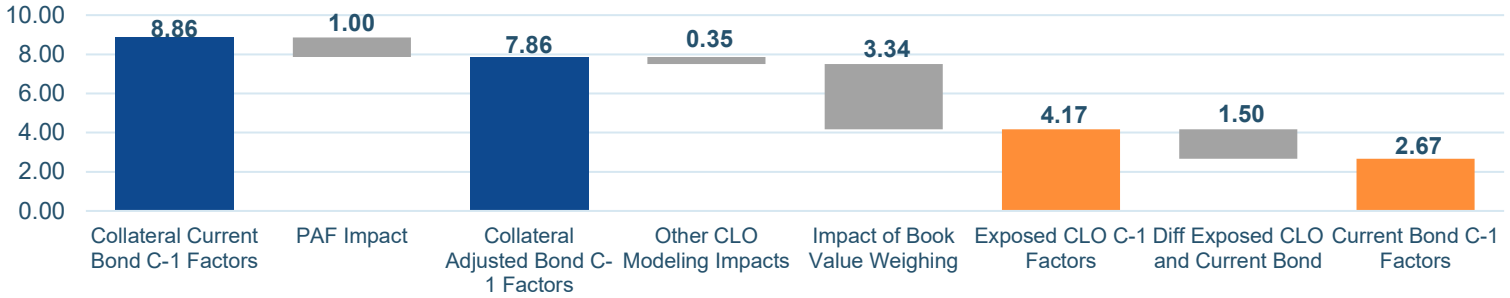
Collateral Bond C-1 Factors vs. Exposed CLO C-1 Factors

Diversification (via PAF) and residual tranche BV accounting explain the difference between Exposed CLO C-1 factors and the collateral Current Bond C-1 Factors



Equal-weighted averages across the CLO deal universe are shown for:

a) Collateral Base RBC = The base RBC ratio for a CLO's underlying loan collateral, using Current Bond C-1 Factors
b) Collateral Adjusted RBC = The collateral RBC ratio after applying full universe portfolio adjustment factor (PAF)
c) Exposed CLO C-1 Factors = BV-weighted Exposed CLO C-1 Factors for a vertical slice
d) Current C-1 Bond Factors = BV-weighted Current Bond C-1 Factors for a vertical slice

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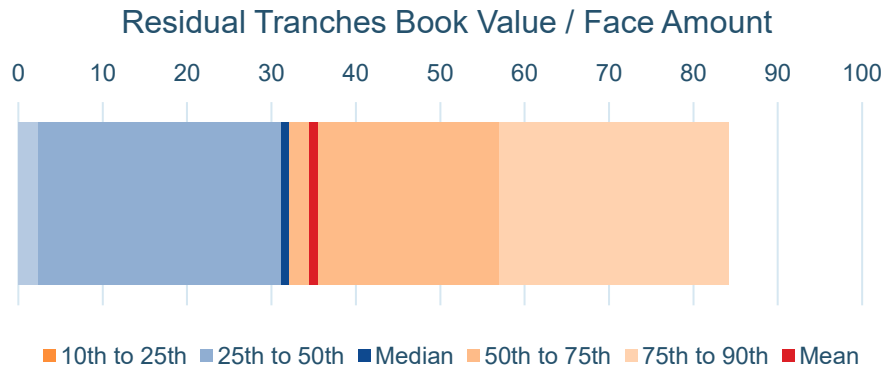
Residual Tranches Book Value vs. Face Amount

Residual tranche book values diverge from the underlying loan balance after issuance date.

Under Practical Expedient, the CLO deal universe has an average ratio of 35.02% and a median of 31.65%.



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Questions?

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