

# C-1 Subcommittee Update on CLO C-1 Factors Modeling

March 2, 2026

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Chairperson, C-1 Subcommittee

## About the Academy

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## Introduction

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- The C-1 Subcommittee & the NAIC's Structured Securities Group (SSG) have collaborated to build a working model for CLO C-1.
- Modeled C-1 factors are shown based on ratings. The Academy has found ratings to include substantial information on tail risk so that ratings can serve as a comparable attribute when appropriate adjustments are made for horizon and tranche thickness.
- Results are broadly consistent with work done by SSG in the CLO ad hoc group, showing low risk for senior tranches but potential cliff risk for junior tranches.
- Factors are horizon-neutral.

## Methodology Summary

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- Objective: Define several risk buckets for CLOs according to comparable attributes and then assign a C-1 factor to each bucket.
- CLO collateral credit modeling is largely consistent with C-1 corporate bond modeling.
- Projection of CLO cash flows is largely consistent with SSG modeling in the CLO Ad Hoc group, with the primary exception being the CLO collateral credit modeling.
- Conversion of CLO cash flows into C-1 factors is consistent with C-1 corporate bond methodology where possible, with additional modeling to address the fact that missed payments on CLOs do not necessarily trigger defaults.

## Anticipated Project Timeline

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- Sept. 8, 2025—initial presentation of model
- Dec. 15, 2025—status update to regulators
- Early 2026—presentation of residual tranche results, portfolio adjustment factor, model refinements, identification of potential comparable attributes, and resulting factors
- Q1 2026—incorporation of modifications requested by regulators, if any
- Q2 2026—If significant changes are not requested by regulators, expectation is for final factors to be available for exposure by April 30, 2026

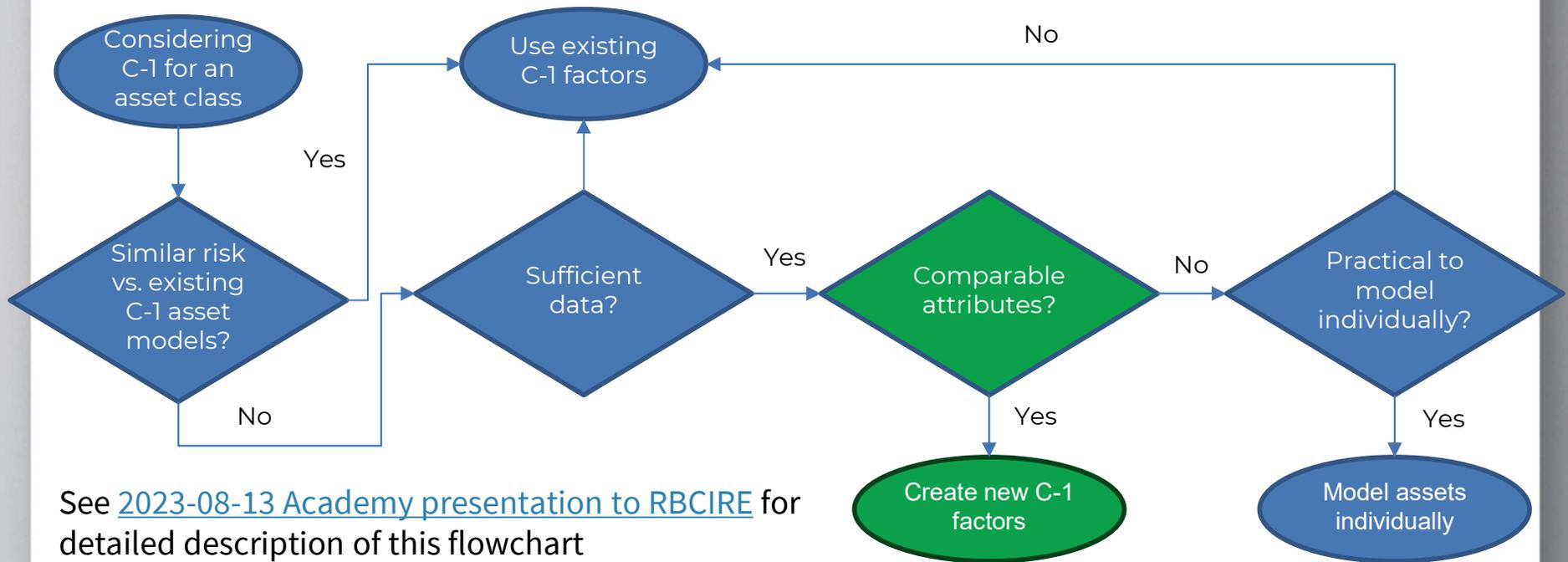
WE ARE  
HERE

## Acknowledgments

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- ACLI—use of C-1 corporate bond model developed by Moody’s for ACLI
- Moody’s—access to CLO deal data, collateral data, historical default rate data, and CDOnet
- S&P—historical recovery data and frequent discussions with structured finance analytical professionals
- Bridgeway Analytics—frequent discussions on credit modeling, structured finance, and help in understanding the ACLI & Moody's corporate bond model
- NAIC SSG—modeling advice and running CDOnet
- NAIC Accounting Staff—guidance on CLO statutory accounting and reporting

# C-1 Modeling Framework Flowchart



See [2023-08-13 Academy presentation to RBCIRE](#) for detailed description of this flowchart

## Project Status Update as of March 2, 2026

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- This presentation includes modeled base factors for CLO debt tranches.
- The Academy will quickly follow-up with modeled portfolio adjustment factors and residual tranche treatment.

## Key Definitions

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**Raw C-1 Factors** refer to the factors estimated using a 3-step modeling process (collateral model, cash flow model, and C-1 factor model) for the universe of CLOs in-scope, as described in the American Academy of Actuaries materials presented at the September 3, 2025, and December 12, 2025, NAIC RBC IRE public calls. Raw C-1 Factors are unique to each asset.

**Modeled C-1 Factors** refer to the factors derived using the comparable attributes modeling approach described in this presentation. Modeled C-1 Factors apply to asset groupings.

**Tranche Thickness** is defined as the difference between the detachment point and attachment point, both expressed as a % of the CLO balance, for a given tranche.

**Reinvestment Horizon** is defined as the time during which a CLO can reinvest principal payments made on its collateral into new loans.

# Modeled C-1 Factors for CLO Debt Tranches

## Modeled Comparable Attributes

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- Modeled tail risk can be largely explained by a combination of three attributes: remaining reinvestment horizon, rating, and tranche thickness.
- C-1 factors for other asset classes are horizon-neutral, therefore the C-1 factor for a given CLO debt tranche should not depend on its remaining reinvestment horizon.
- After adjusting for systematic differences in reinvestment horizons across ratings, CLO debt tranches can be sorted according to two comparable attributes: rating and tranche thickness (with tranche thickness only needed for CLO debt tranches rated Baa3 and lower).
- Tranche thickness can be treated in a simple manner, by dividing each rating into just two categories: tranche thickness greater than 4% and tranche thickness less than 4%.
- Alternative results are also presented that ignore tranche thickness, prioritizing ease of implementation in a rating-only framework

## Option 1—Rating Only (After-Tax Factors)

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### Investment Grade

Rating	Simple Average Raw C-1	Modeled C-1
Aaa	0.03%	<b>0.03%</b>
Aa1	0.28%	<b>0.04%</b>
Aa2	0.00%	<b>0.04%</b>
Aa3	0.00%	<b>0.04%</b>
A1	0.40%	<b>0.14%</b>
A2	0.11%	<b>0.14%</b>
A3	0.12%	<b>1.45%</b>
Baa1	1.58%	<b>1.81%</b>
Baa2	3.02%	<b>2.70%</b>
Baa3	5.94%	<b>2.73%</b>

### Below Investment Grade

Rating	Simple Average Raw C-1	Modeled C-1
Ba1	20.70%	<b>12.59%</b>
Ba2	27.37%	<b>20.93%</b>
Ba3	28.92%	<b>23.28%</b>
B1	17.34%	<b>26.04%</b>
B2	30.81%	<b>35.20%</b>
B3	56.39%	<b>47.32%</b>
Caa1	57.60%	<b>48.12%</b>
Caa2	66.51%	<b>55.20%</b>
Caa3	77.33%	<b>70.82%</b>

## Option 2—Rating & Tranche Thickness (After-Tax Factors)

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### Investment Grade

Rating	Simple Average Raw C-1	Modeled C-1	
		Thickness > 4%	Thickness ≤ 4%
Aaa	0.03%	<b>0.03%</b>	
Aa1	0.28%	<b>0.04%</b>	
Aa2	0.00%	<b>0.04%</b>	
Aa3	0.00%	<b>0.04%</b>	
A1	0.40%	<b>0.14%</b>	
A2	0.11%	<b>0.14%</b>	
A3	0.12%	<b>1.45%</b>	
Baa1	1.58%	<b>1.81%</b>	
Baa2	3.02%	<b>2.70%</b>	
Baa3	5.94%	<b>2.73%</b>	<b>12.52%</b>

### Below Investment Grade

Rating	Simple Average Raw C-1	Modeled C-1	
		Thickness > 4%	Thickness ≤ 4%
Ba1	20.70%	<b>12.59%</b>	<b>22.39%</b>
Ba2	27.37%	<b>20.93%</b>	<b>30.72%</b>
Ba3	28.92%	<b>23.28%</b>	<b>33.08%</b>
B1	17.34%	<b>26.04%</b>	<b>35.84%</b>
B2	30.81%	<b>35.20%</b>	<b>44.99%</b>
B3	56.39%	<b>47.32%</b>	<b>57.12%</b>
Caa1	57.60%	<b>48.12%</b>	<b>57.92%</b>
Caa2	66.51%	<b>55.20%</b>	<b>64.99%</b>
Caa3	77.33%	<b>70.82%</b>	<b>80.61%</b>

# Appendix 1—Methodology for C-1 Factors

## Methodology for Modeled C-1 Factors

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1. Ordinary Least Squares (“OLS”) regression C-1 factor model
2. Adjustments for remaining reinvestment horizon
3. Adjustments for tranche thickness
4. Isotonic regression (on CLO debt tranches rated Baa2 and higher)

# Methodology for Modeled C-1 Factors

## 1. OLS Regression Model

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The OLS regression model used to produce Modeled C-1 Factors uses the following independent variables:

- Ratings (19 indicator variables, one per rating)
- Reinvestment horizon (1 numerical variable)
- Interaction terms between reinvestment horizon and rating (6 interaction terms)
- Tranche thickness (1 indicator variable)

The adjusted  $R^2$  for a ratings-only regression is 74.2%. Adding reinvestment horizon increases the adjusted  $R^2$  to 76.2%. Adding interaction terms between reinvestment horizon and ratings increases  $R^2$  to 81.6%. Adding the tranche thickness flag increases  $R^2$  to 83.2%.

C-1 factors are produced using an unweighted OLS, rather than weighted by \$ balance.

## Methodology for Modeled C-1 Factors

### 2. Adjustment for Remaining Reinvestment Horizon

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We observe reinvestment horizon is predictive of raw C-1 factors; when a security has a shorter reinvestment horizon, its raw C-1 factor is on average smaller.

The effect of reinvestment horizon on C-1 varies by rating—C-1 and its slope is  $\sim 0$  for Aaa/Aa but increases especially at Baa and below IG

Because Caa has materially fewer data points, we bucket Caa with B3 and offset all other ratings (i.e., B2/B1/Ba3 and Ba2/Ba1/Baa3 etc.) for the purpose of interaction terms which results in a minor improvement to  $R^2$  and produces monotonicity for all below-IG ratings.

We observed no correlation between reinvestment horizon and rating (p-value = 0.19). Because non-CLO C-1 factors are horizon-neutral, the modeled C-1 factors are derived by using the average reinvestment horizon across ratings of 2.41 years (balance-weighted average is near-identical at 2.40 years).

## Methodology for Modeled C-1 Factors

### 3. Adj. for tranche thickness and 4. Isotonic Regression (Baa2 / above)

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After adjusting for reinvestment horizon, an isotonic regression is applied to produce monotonic C-1 factors across rating.

Rating	Simple Average Raw C-1	Modeled C-1, Reinvestment Adjusted	Modeled C-1, Isotonic Regression Applied
Aaa	0.03%	0.03%	0.03%
Aa1	0.28%	0.27%	0.04%
Aa2	0.00%	0.00%	0.04%
Aa3	0.00%	0.04%	0.04%
A1	0.40%	0.41%	0.14%
A2	0.11%	0.10%	0.14%
A3	0.12%	1.45%	1.45%
Baa1	1.58%	1.81%	1.81%
Baa2	3.02%	2.70%	2.70%

Note that the shift in A3 from 0.12% simple average of raw C-1 to 1.45% with reinvestment adjustment is due to the relatively short horizons present in the A3 tranches in the dataset. Also note that A3 tranches are less common than A2.

# Methodology for Modeled C-1 Factors

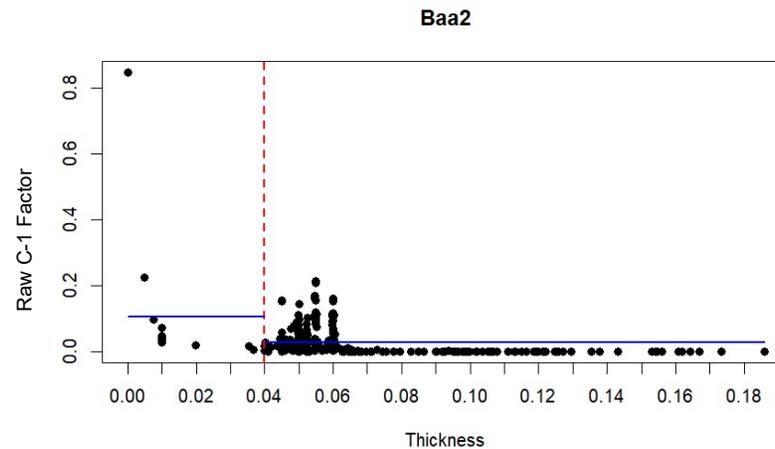
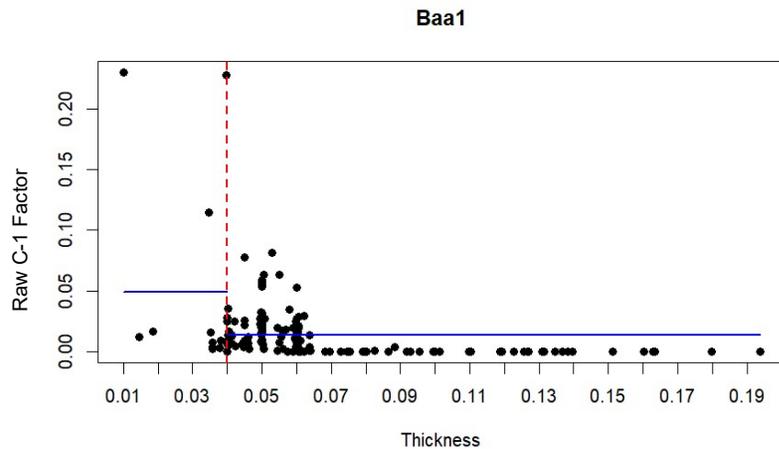
## 3. Adjustments for tranche thickness (Baa3 / below)

Factors are monotonic after spiking out thickness and accounting for horizon

Rating	Simple Average Raw C-1	Simple Average Raw C-1		Modeled C-1, Reinvestment Adjusted	
		Thickness > 4%	Thickness ≤ 4%	Thickness > 4%	Thickness ≤ 4%
Baa3	5.94%	2.33%	16.27%	2.73%	12.52%
Ba1	20.70%	3.39%	26.09%	12.59%	22.39%
Ba2	27.37%	8.82%	38.13%	20.93%	30.72%
Ba3	28.92%	19.87%	35.61%	23.28%	33.08%
B1	17.34%	13.68%	53.96%	26.04%	35.84%
B2	30.81%	12.68%	65.04%	35.20%	44.99%
B3	56.39%	31.15%	57.35%	47.32%	57.12%
Caa1	57.60%	35.50%	67.07%	48.12%	57.92%
Caa2	66.51%	39.12%	70.16%	55.20%	64.99%
Caa3	77.33%	74.61%	81.47%	70.82%	80.61%

## Appendix 2—Modeling Choices

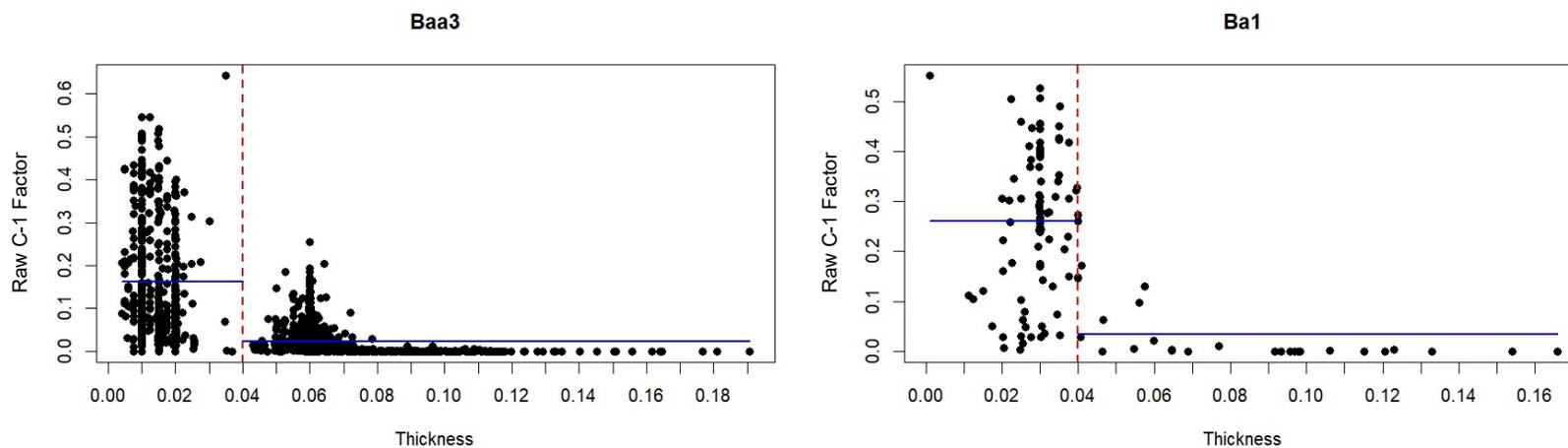
# Tranche Thickness 4% Cut-Off Baa1/Baa2



The scatterplots above show the relationship between tranche thickness and raw C-1 factor within a single rating bucket. Each dot represents one CLO debt tranche. The blue horizontal lines show the average raw C-1 factor across the dataset for CLO debt tranches of the given rating and tranche thickness (less than or equal vs. greater than 4%). The difference between the blue lines shows that tranche thickness provides information on tail risk, as represented by the raw C-1 factor, that is not captured by ratings.

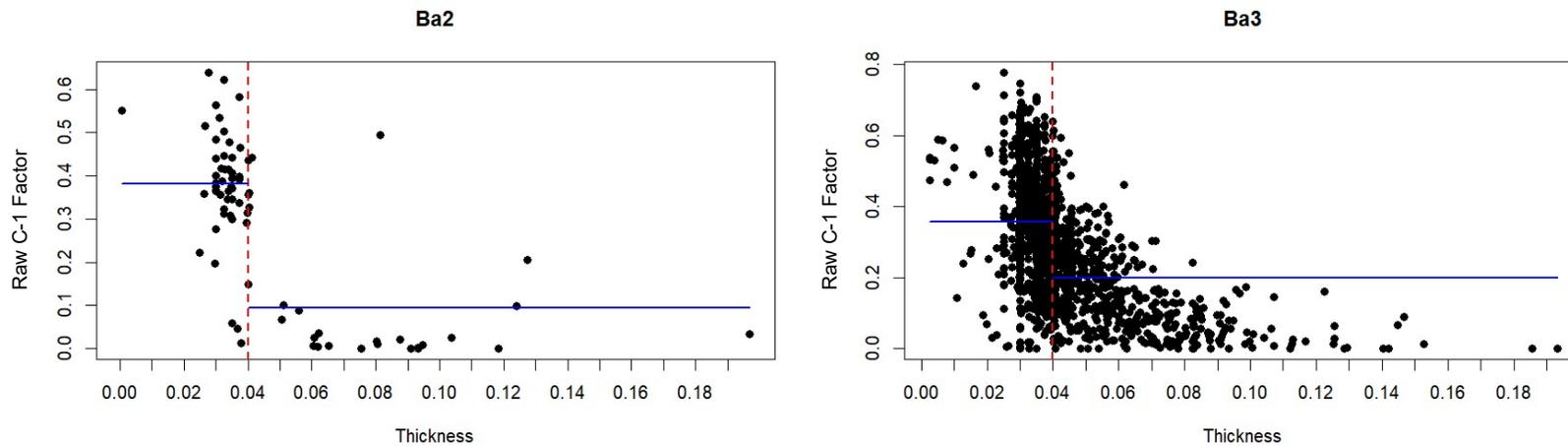
Tranche thickness is not included as a comparable attribute in modeled factors for Baa1 and Baa2 due to low sample size in these ratings, even though the pattern can be observed here.

# Tranche Thickness 4% Cut-Off Baa3/Ba1



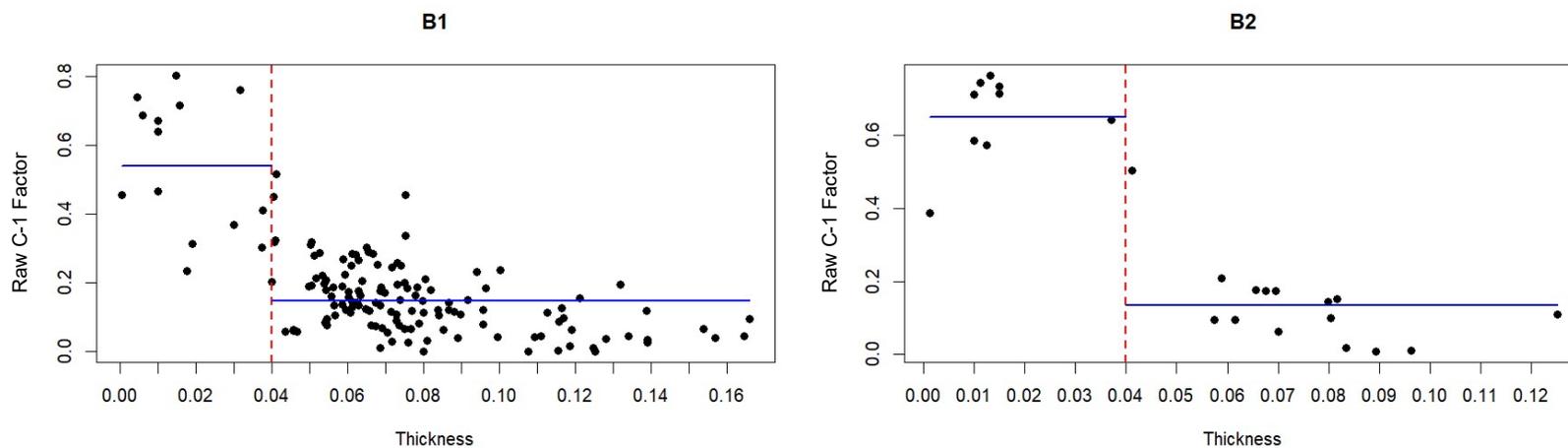
The scatterplots above show the relationship between tranche thickness and raw C-1 factor within a single rating bucket. Each dot represents one CLO debt tranche. The blue horizontal lines show the average raw C-1 factor across the dataset for CLO debt tranches of the given rating and tranche thickness (less than or equal vs. greater than 4%). The difference between the blue lines shows that tranche thickness provides information on tail risk, as represented by the raw C-1 factor, that is not captured by ratings.

# Tranche Thickness 4% Cut-Off Ba2/Ba3



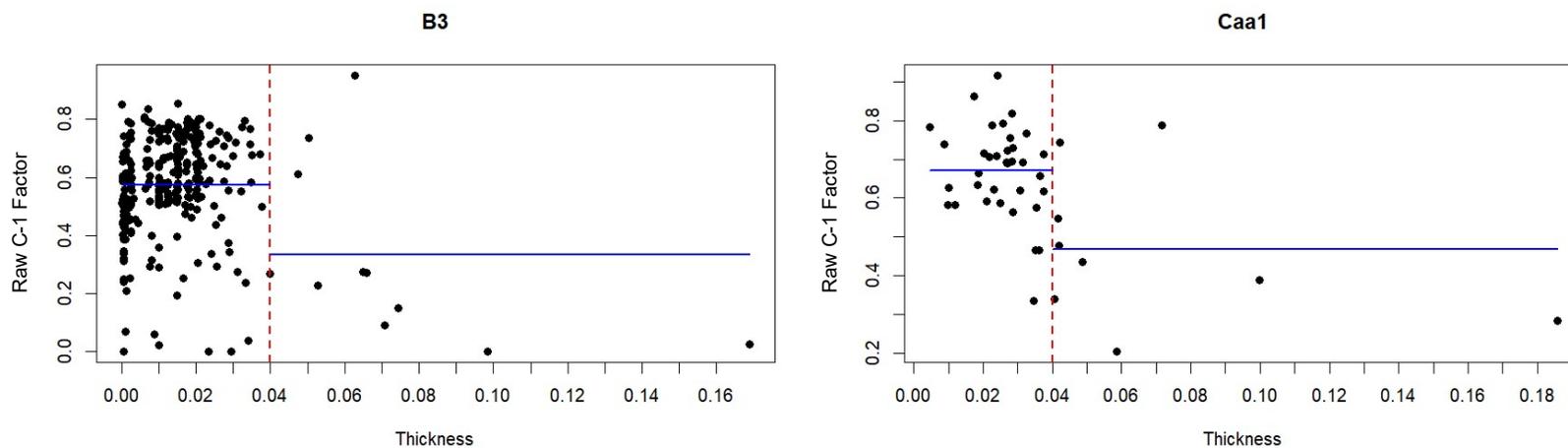
The scatterplots above show the relationship between tranche thickness and raw C-1 factor within a single rating bucket. Each dot represents one CLO debt tranche. The blue horizontal lines show the average raw C-1 factor across the dataset for CLO debt tranches of the given rating and tranche thickness (less than or equal vs. greater than 4%). The difference between the blue lines shows that tranche thickness provides information on tail risk, as represented by the raw C-1 factor, that is not captured by ratings.

# Tranche Thickness 4% Cut-Off B1/B2



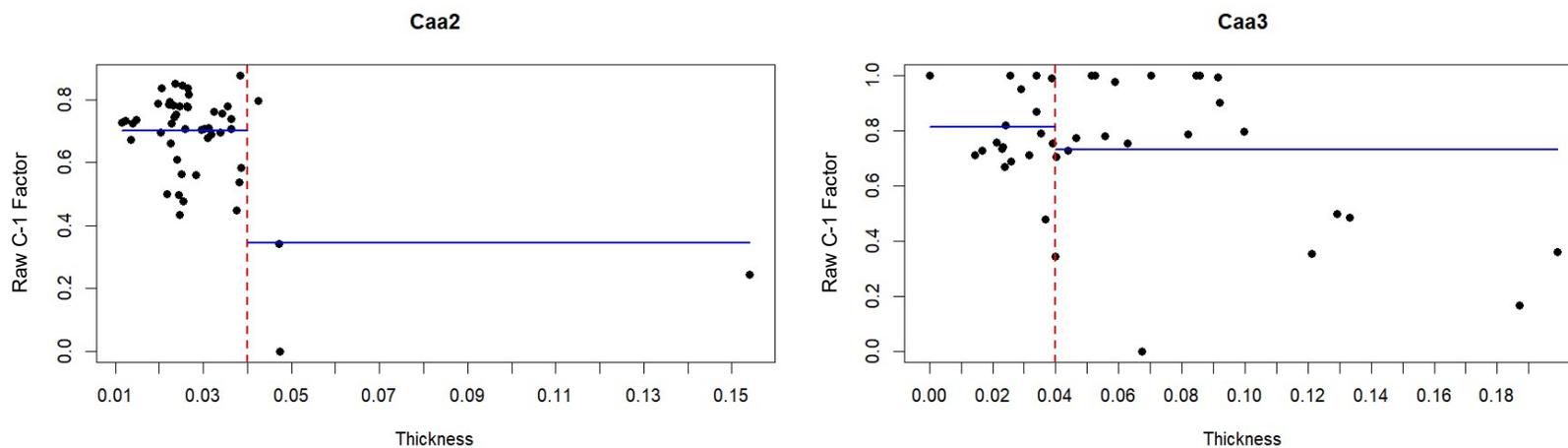
The scatterplots above show the relationship between tranche thickness and raw C-1 factor within a single rating bucket. Each dot represents one CLO debt tranche. The blue horizontal lines show the average raw C-1 factor across the dataset for CLO debt tranches of the given rating and tranche thickness (less than or equal vs. greater than 4%). The difference between the blue lines shows that tranche thickness provides information on tail risk, as represented by the raw C-1 factor, that is not captured by ratings.

# Tranche Thickness 4% Cut-Off B3/Caa1



The scatterplots above show the relationship between tranche thickness and raw C-1 factor within a single rating bucket. Each dot represents one CLO debt tranche. The blue horizontal lines show the average raw C-1 factor across the dataset for CLO debt tranches of the given rating and tranche thickness (less than or equal vs. greater than 4%). The difference between the blue lines shows that tranche thickness provides information on tail risk, as represented by the raw C-1 factor, that is not captured by ratings.

# Tranche Thickness 4% Cut-Off Caa2/Caa3

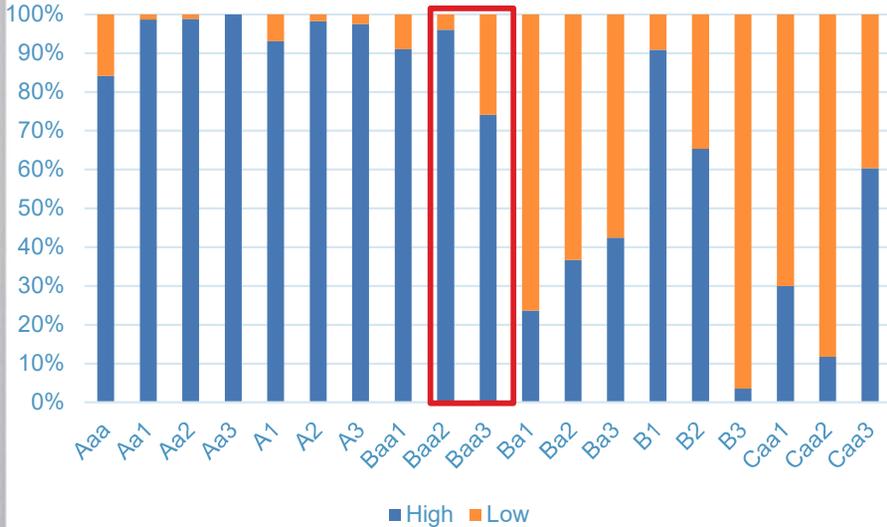


The scatterplots above show the relationship between tranche thickness and raw C-1 factor within a single rating bucket. Each dot represents one CLO debt tranche. The blue horizontal lines show the average raw C-1 factor across the dataset for CLO debt tranches of the given rating and tranche thickness (less than or equal vs. greater than 4%). The difference between the blue lines shows that tranche thickness provides information on tail risk, as represented by the raw C-1 factor, that is not captured by ratings.

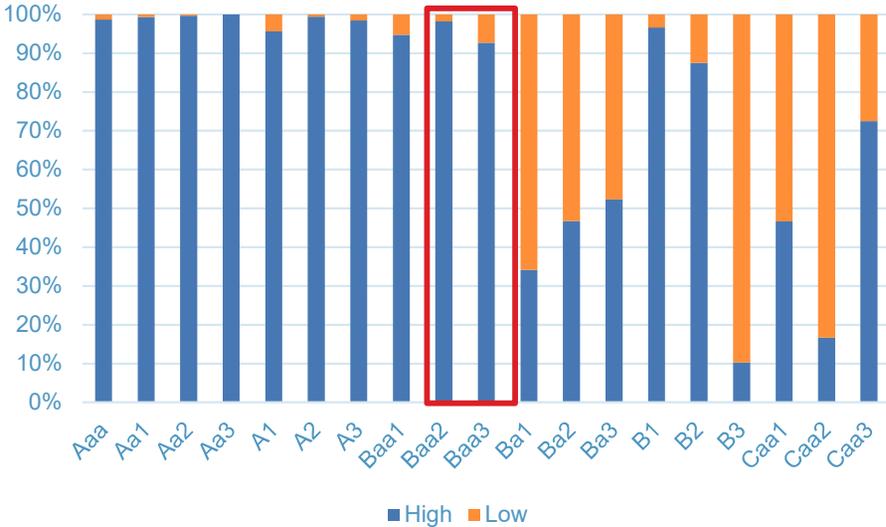
# Distribution by Tranche Thickness

Differences between Baa2 and Baa3 tranche thickness are driven by securities with smaller \$ balances. In other words, the intuitive result holds that thin tranches have smaller \$ balances than thick tranches for most ratings.

High vs. Low Thickness (by Frequency)



High vs. Low Thickness (by Balance)



\*High vs. low is defined as greater than vs. less than 4%

## Distribution by Tranche Thickness

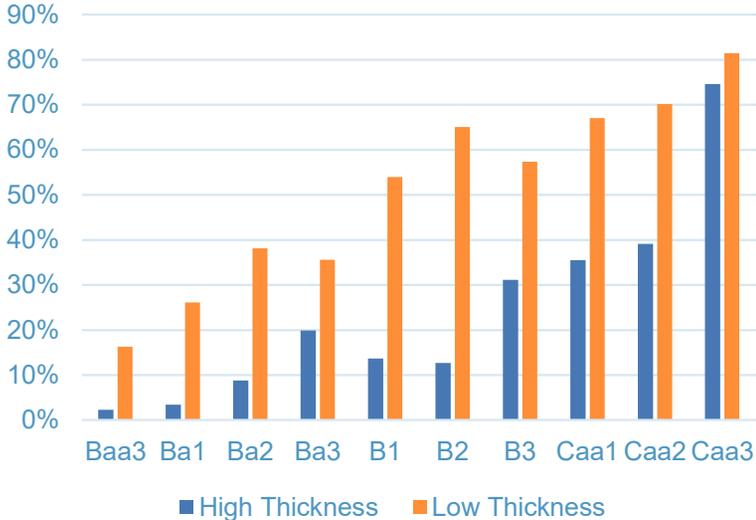
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	Counts		Balance		Difference (Balance - Counts)	
	High	Low	High	Low	High	Low
Aaa	84%	16%	99%	1%	15%	-15%
Aa1	99%	1%	99%	1%	1%	-1%
Aa2	99%	1%	100%	0%	1%	-1%
Aa3	100%	0%	100%	0%	0%	0%
A1	93%	7%	96%	4%	3%	-3%
A2	98%	2%	99%	1%	1%	-1%
A3	98%	2%	98%	2%	1%	-1%
Baa1	91%	9%	95%	5%	4%	-4%
Baa2	96%	4%	98%	2%	2%	-2%
Baa3	74%	26%	93%	7%	19%	-19%
Ba1	24%	76%	34%	66%	10%	-10%
Ba2	37%	63%	47%	53%	10%	-10%
Ba3	43%	57%	52%	48%	10%	-10%
B1	91%	9%	97%	3%	6%	-6%
B2	65%	35%	88%	12%	22%	-22%
B3	4%	96%	10%	90%	7%	-7%
Caa1	30%	70%	47%	53%	17%	-17%
Caa2	12%	88%	17%	83%	5%	-5%
Caa3	60%	40%	73%	27%	12%	-12%

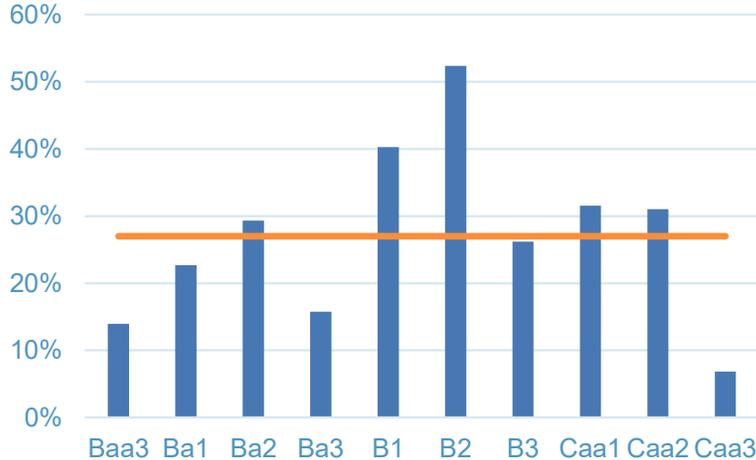
# Raw C-1 Factor Averages by Tranche Thickness

Differences between high thickness and low thickness factors do not trend across rating and only have minor improvements to model fit; we use one premium across all ratings to avoid overfitting

Average C-1 Factors



Difference (High – Low Thickness)

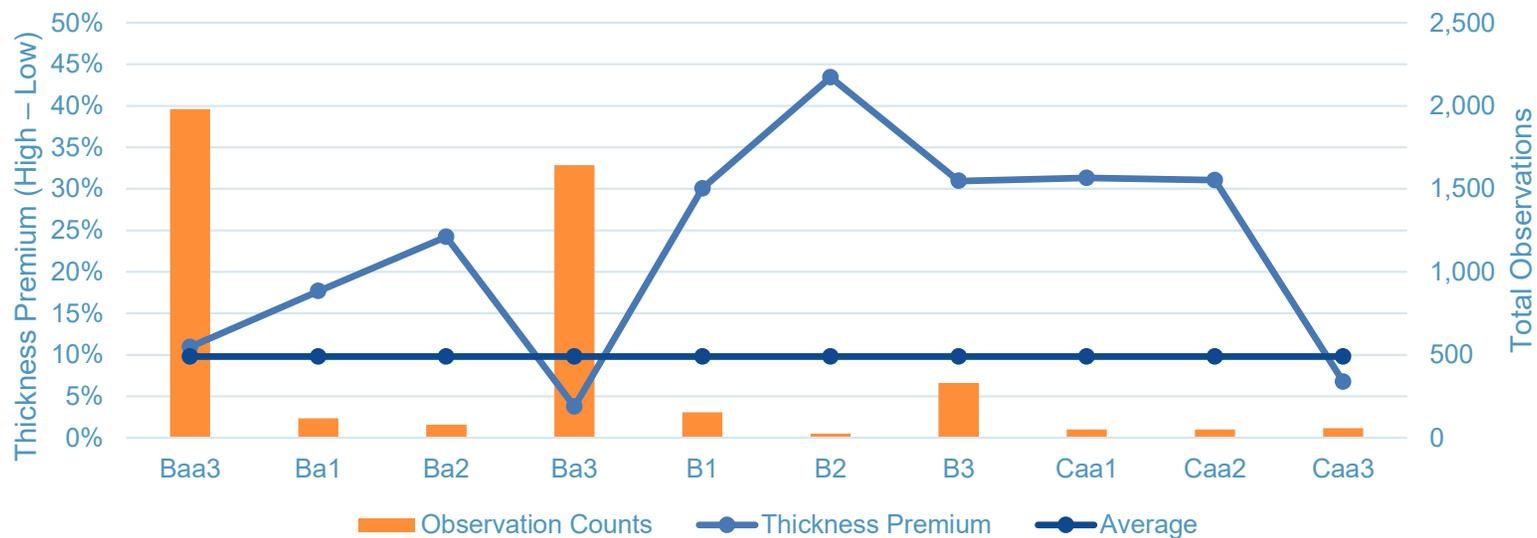


\*Applying regression to standardize reinvestment horizon to mean, spiking out 4% thickness for Baa3/below and applying isotonic regression to A2/above

## Model\* Output Thickness Premiums

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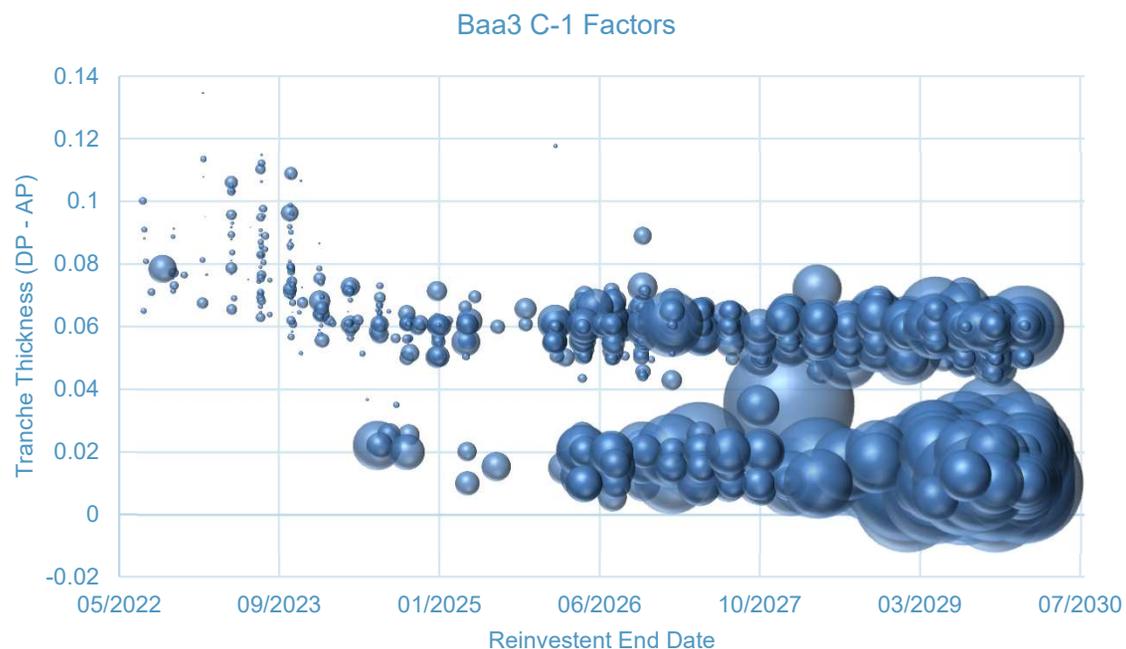
After accounting for reinvestment horizon (see next section) and estimating the thickness premium at each rating, we observe noisy results for B1/below and elect to use a single average across all Baa3/below ratings



## Tranche Thickness and Reinvestment Horizon

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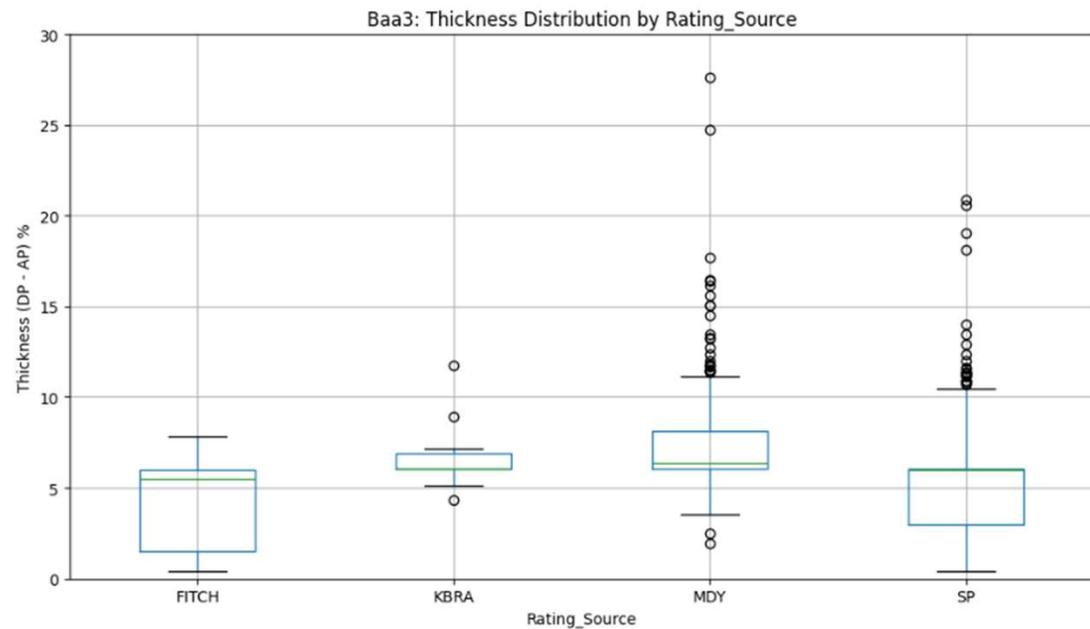
- Within Baa3 tranches, two distinct groups are represented here by two horizontal lines of bubbles.
- Each bubble represents one CLO debt tranche, with larger bubbles having higher C-1 factors.
- Bubbles are larger in the bottom row, showing that thin tranches are riskier.
- Bubbles are larger on the right, showing that longer remaining reinvestment horizons have more modeled risk.



## Tranche Thickness by Rating Agency

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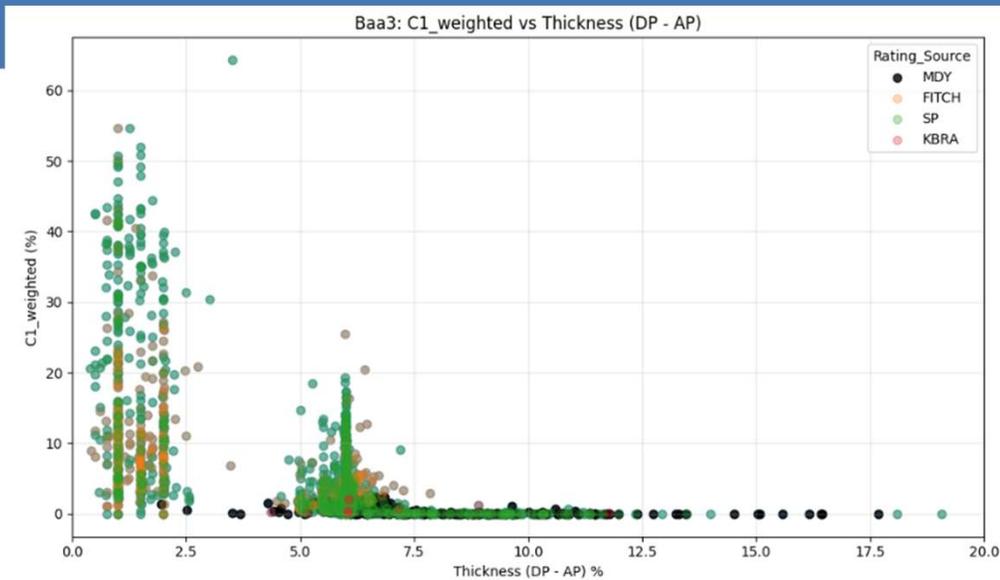
- Thinner tranches can qualify for an investment-grade rating from S&P or Fitch, which rate to the first dollar of loss (attachment point drives rating, detachment point does not).
- Moody's and KBRA\* ratings incorporate severity of loss, as do modeled C-1 factors, and thus higher detachment points tend to be required for an investment-grade rating from Moody's or KBRA\*.



\*KBRA is drawn from a smaller sample size in the data-set, consisting of only 10 Baa3 CLOs (see following slide for further details on the dataset)

# Tranche Thickness by Rating Agency

- Baa3 CLOs are clustered at a 6% thickness (typical Baa3 attaches at 12% and detaches at 18%).
- Moody's ratings (black dots) tend to have higher thickness than S&P ratings (green dots).



Thickness Distribution by Rating\_Source (Baa3 only):

index	Rating_Source	count	mean	std	total_balance	avg_C1_weighted	simple_avg_C1	bal_thickness_<4%	bal_thickness_>=4%
0	FITCH	583	3.98	2.29	10371142500	4.5219	6.8773	15.35	84.65
1	KBRA	10	6.76	2.13	347144739	0.8527	0.7481	0	100
2	MDY	354	7.73	5.36	10257986866	0.6521	0.6579	0.76	99.24
3	SP	1033	5.19	2.65	23010314334	3.774	7.2659	6.72	93.28

## Reinvestment Horizon

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- Adjusting reinvestment horizon to mean fixes non-monotonicity in average C-1 factors, among below investment grade ratings.

Rating	High Thickness		Low Thickness	
	Simple Average	Constant Reinvestment Horizon	Simple Average	Constant Reinvestment Horizon
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%	16.27%	12.52%
Ba1	20.70%	12.59%	26.09%	22.39%
Ba2	27.37%	20.93%	38.13%	30.72%
Ba3	28.92%	23.28%	35.61%	33.08%
B1	17.34%	26.04%	53.96%	35.84%
B2	30.81%	35.20%	65.04%	44.99%
B3	56.39%	47.32%	57.35%	57.12%
Caa1	57.60%	48.12%	67.07%	57.92%
Caa2	66.51%	55.20%	70.16%	64.99%
Caa3	77.33%	70.82%	81.47%	80.61%

\*The effect of reinvestment horizon on C-1 is not homogenous across ratings. Due to data limitations (total observations and variance in C-1), not all ratings are credible enough to have their own interaction term; buckets were chosen to optimize adjusted  $R^2$ .

## Reinvestment Horizon

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Ratings with short reinvestment horizons have suppressed average C-1 factors

To estimate this effect, we regress C-1 against reinvestment horizon, with interactions to the following buckets\*:

Bucket 1: Aaa

Bucket 2: Aa1, Aa2

Bucket 3: Aa3, A1, A2

Bucket 4: A3, Baa1, Baa2

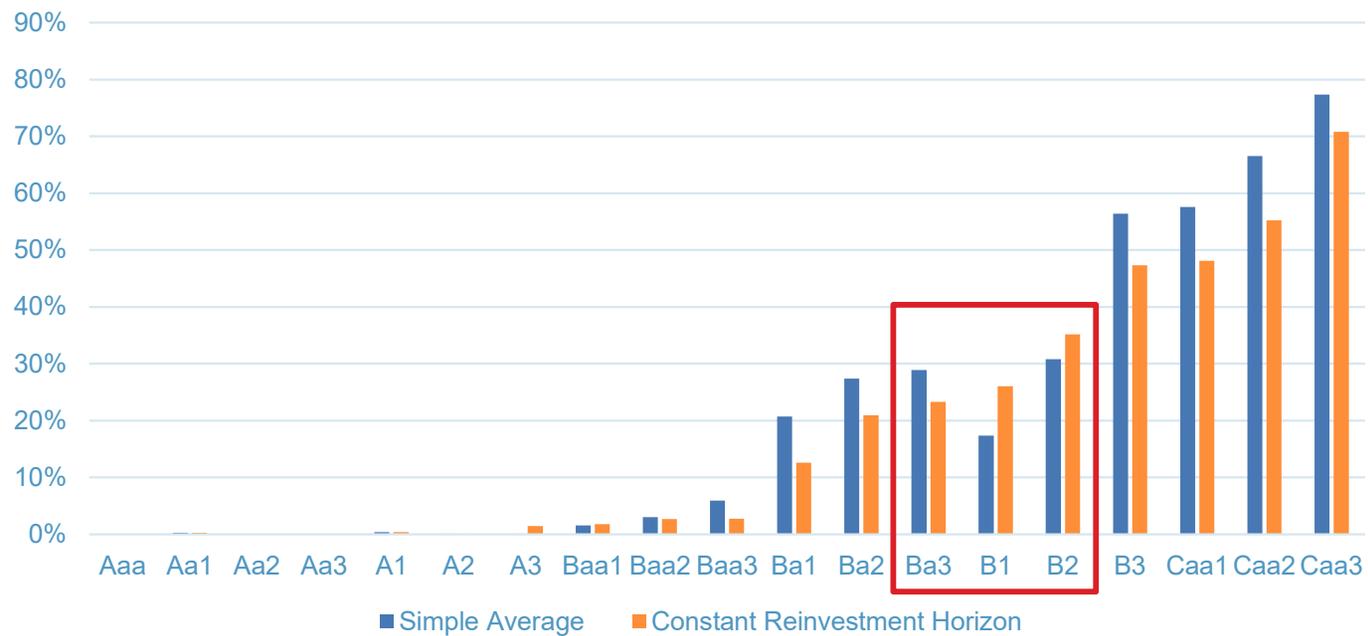
Bucket 5: Baa3, Ba1, Ba2

Bucket 6: Ba3, B1, B2

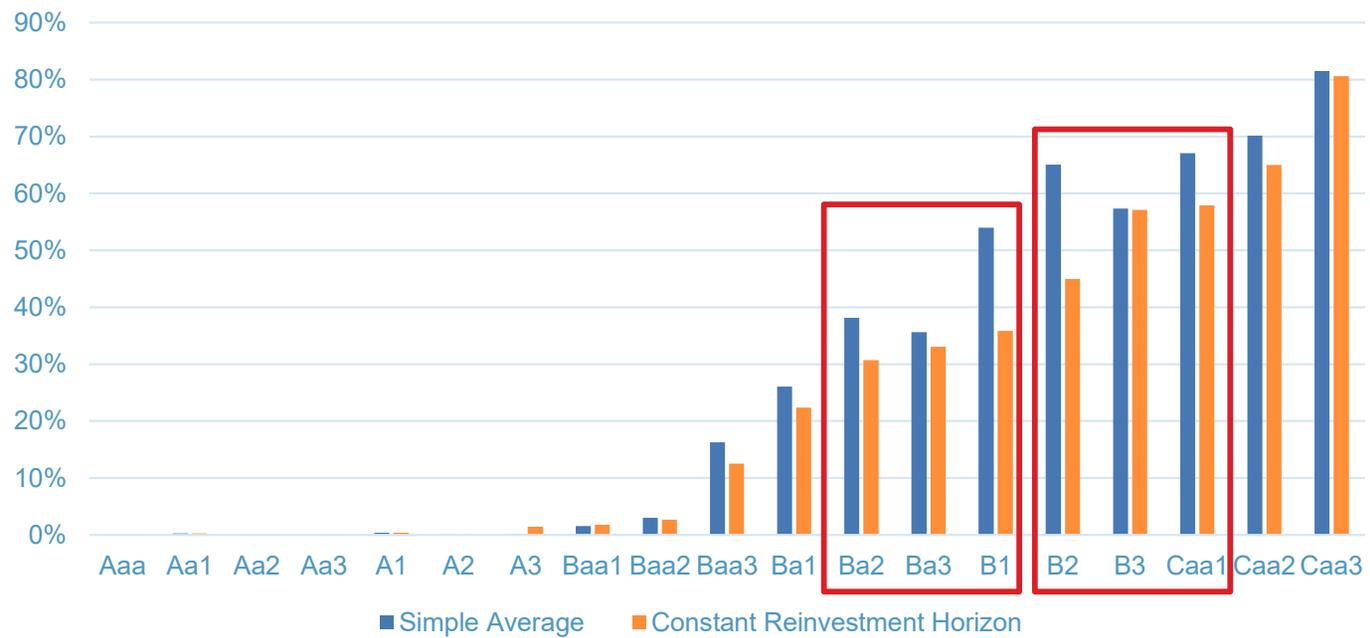
Bucket 7: B3, Caa1, Caa2, Caa3



# Reinvestment Horizon—High Thickness Factors



# Reinvestment Horizon—Low Thickness Factors



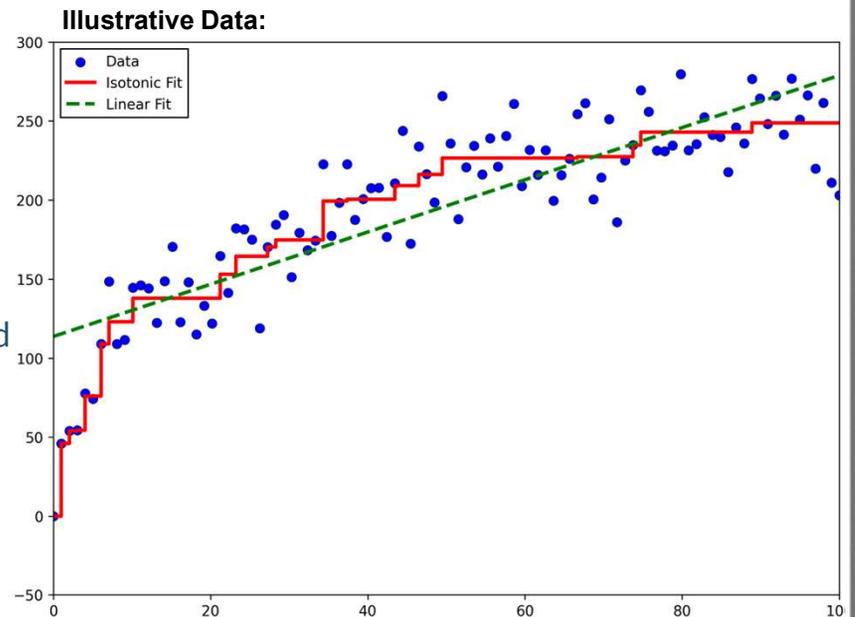
# Isotonic Regression

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- For  $x_1 \leq x_2 \leq \dots \leq x_n$ , the isotonic regression solves:

$$\min_{\hat{y}_1, \dots, \hat{y}_n} \sum_{i=1}^n (y_i - \hat{y}_i)^2 \text{ s.t. } \hat{y}_1 \leq \hat{y}_2 \leq \dots \leq \hat{y}_n$$

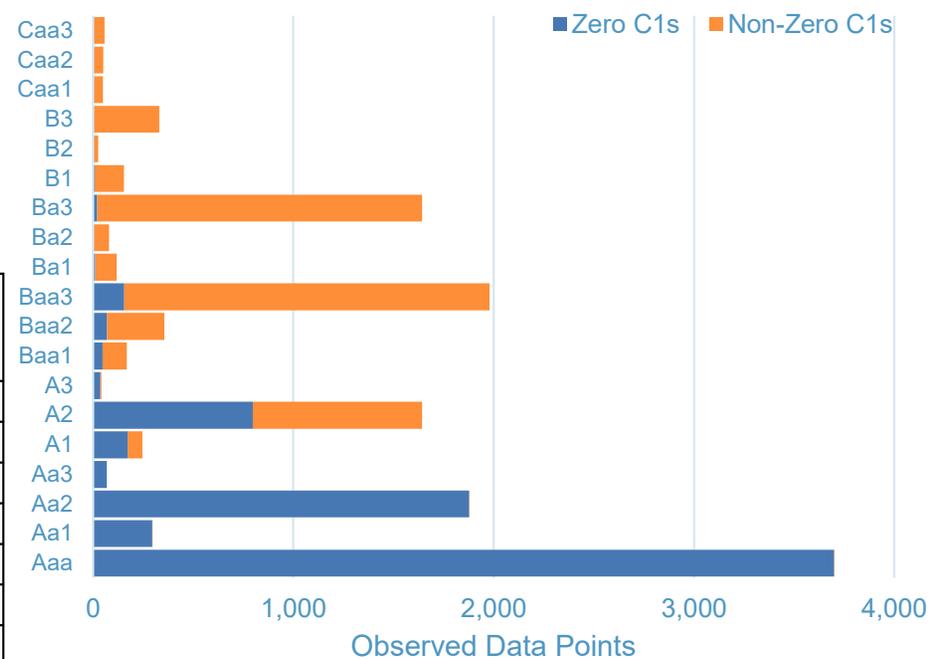
- The isotonic regression forces **monotonicity**, i.e., constrains data to be non-decreasing.
- The result is a **stepwise** fit where the steps correspond to weighted averages of the local points.
- The **Pool-Adjacent-Violators (PAV) algorithm** starts with  $y_i = \hat{y}_i$  and identifies points 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.



## Isotonic Regression—Applied to A3/above CLO C-1 Factors 39

- Average C-1 factors are not monotonic across rating for Aa1 to A2.
- The frequency for non-zero C-1 factors is too low for factors to be credible for Aa1 to A2.
- Isotonic regression smooths the average C-1s.

	Total Observations	Non-Zero C-1 Observations	Average C-1 Factors	Isotonic C-1 Factors
Aaa	3,701	2	0.03%	0.03%
Aa1	297	1	0.27%	0.04%
Aa2	1,879	1	0.00%	0.04%
Aa3	68	0	0.04%	0.04%
A1	246	73	0.41%	0.14%
A2	1,642	844	0.10%	0.14%
A3	41	5	1.45%	1.45%



## Equal-Weighted (Simple) vs. Balance-Weighted Raw C-1

### All Tranches

Rating	Counts	Non-Zero C-1 Counts	Simple Average	Weighted Average	Diff
Aaa	3,701	2	0.03%	0.01%	-0.02%
Aa1	297	1	0.28%	0.31%	0.03%
Aa2	1,879	1	0.00%	0.00%	0.00%
Aa3	68	-	0.00%	0.00%	0.00%
A1	246	73	0.40%	0.38%	-0.02%
A2	1,642	844	0.11%	0.10%	-0.01%
A3	41	5	0.12%	0.13%	0.01%
Baa1	168	120	1.58%	1.33%	-0.24%
Baa2	356	286	3.02%	2.56%	-0.46%
Baa3	1,980	1,824	5.94%	3.20%	-2.74%
Ba1	118	107	20.70%	19.21%	-1.50%
Ba2	79	75	27.37%	23.67%	-3.70%
Ba3	1642	1621	28.92%	26.65%	-2.27%
B1	154	146	17.34%	15.46%	-1.89%
B2	26	25	30.81%	18.70%	-12.10%
B3	330	326	56.39%	57.38%	0.99%
Caa1	50	50	57.60%	49.49%	-8.10%
Caa2	51	50	66.51%	65.78%	-0.73%
Caa3	58	57	77.33%	70.71%	-6.62%

- Average C-1 factors tend to be **lower** when weighting by current balance, as opposed to simple average
- This gap is driven by correlation between balance and tranche thickness—it dissipates when accounting for thickness and reinvestment horizon (see next page)
- Because weighted regressions have fewer effective degrees of freedom, we present unweighted results

\*Applying regression to standardize reinvestment horizon to mean, spiking out 4% thickness for Baa3/below and applying isotonic regression to A2/above

## Unweighted vs. Weighted Modeled\* C-1 Factors

### Tranche Thickness > 4%

Rating	Counts	Non-Zero C-1 Counts	Unweighted	Weighted	Diff
Aaa	3,701	2	0.03%	0.01%	-0.02%
Aa1	297	1	0.04%	0.04%	0.00%
Aa2	1,879	1	0.04%	0.04%	0.00%
Aa3	68	-	0.04%	0.04%	0.00%
A1	246	73	0.14%	0.14%	-0.01%
A2	1,642	844	0.14%	0.14%	-0.01%
A3	41	5	1.45%	1.39%	-0.06%
Baa1	168	120	1.81%	1.70%	-0.11%
Baa2	356	286	2.70%	2.44%	-0.26%
Baa3	1,468	1,322	2.73%	2.68%	-0.05%
Ba1	28	17	12.59%	13.09%	0.49%
Ba2	29	25	20.93%	19.23%	-1.70%
Ba3	698	682	23.28%	23.57%	0.29%
B1	140	132	26.04%	25.48%	-0.56%
B2	17	16	35.20%	27.25%	-7.95%
B3	12	11	47.32%	48.53%	1.21%
Caa1	15	15	48.12%	48.53%	0.41%
Caa2	6	5	55.20%	57.99%	2.79%
Caa3	35	34	70.82%	68.02%	-2.80%

### Tranche Thickness <= 4%

Rating	Counts	Non-Zero C-1 Counts	Unweighted	Weighted	Diff
Aaa	3,701	2	0.03%	0.01%	-0.02%
Aa1	297	1	0.04%	0.04%	0.00%
Aa2	1,879	1	0.04%	0.04%	0.00%
Aa3	68	-	0.04%	0.04%	0.00%
A1	246	73	0.14%	0.14%	-0.01%
A2	1,642	844	0.14%	0.14%	-0.01%
A3	41	5	1.45%	1.39%	-0.06%
Baa1	168	120	1.81%	1.70%	-0.11%
Baa2	356	286	2.70%	2.44%	-0.26%
Baa3	512	502	12.52%	11.79%	-0.73%
Ba1	90	90	22.39%	22.20%	-0.19%
Ba2	50	50	30.72%	28.34%	-2.38%
Ba3	944	939	33.08%	32.69%	-0.39%
B1	14	14	35.84%	34.59%	-1.24%
B2	9	9	44.99%	36.36%	-8.64%
B3	318	315	57.12%	57.65%	0.53%
Caa1	35	35	57.92%	57.65%	-0.27%
Caa2	45	45	64.99%	67.10%	2.11%
Caa3	23	23	80.61%	77.13%	-3.48%

## Appendix 3—Alternative Models Considered

## Tested Regressions—Part 1

Regression Exogenous Variables	Adjusted R <sup>2</sup>	Number of Parameters	Notes
All Variables, excluding Rating (no transformations)	42.6%	47	Baseline estimate for non-rating characteristics
Attachment Point Percentile Buckets (50 equal-sized)	66.5%	50	
Thickness (DP – AP) Percentile Buckets (50 equal-sized)	45.3%	50	
Detachment Point Percentile Buckets (50 equal-sized)	76.5%	50	New baseline for non-rating characteristics. Downside: agnostic towards underlying credit quality.
Rating	74.2%	19	Baseline for ratings. Explanatory power comparable to detachment point
Rating + Detachment Point	74.4%	20	Adds little additional explanatory power over rating

*Rating modeled as individual indicator variables for each of the 19 ratings*

## Tested Regressions—Part 2

Regression Exogenous Variables	Adjusted R <sup>2</sup>	Number of Parameters	Notes
Rating + Detachment Point Buckets	81.8%	68	Explains an additional 7.6% of variance over ratings only
Rating + Reinvestment Horizon	76.2%	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 + Reinvestment Horizon x Rating (interaction terms with rating)	82.4%	37	Explains an additional 8.2% of variance over ratings only; potential overfitting on thin tranches
Rating + Reinvestment Horizon x Rating Letter (interactions with AAA, AA, A, etc.)	81.6%	26	Loses less than 1% of variance explained Adds credibility to non-standard tranches
Rating + Reinvestment Horizon x Rating Bucket (interactions with B3/below, B2/B1/Ba3, Ba1/Ba2/B3, etc.)	81.6%	26	Comparable R <sup>2</sup> as rating letter; adds credibility to CCC (adds observations and adds variance in horizon)
Rating + Reinvestment Horizon x Rating Bucket + Detachment Point	81.7%	27	Negligible improvement over model without DP

*Rating modeled as individual indicator variables for each of the 19 ratings*

## Tested Regressions—Part 3

Regression Exogenous Variables	Adjusted R <sup>2</sup>	Number of Parameters	Notes
Rating + Reinvestment Horizon x Rating Bucket + Detachment Point Buckets	85.6%	75	Detachment point (at the granular level) explains an additional 4.0% of variance
Rating + Reinvestment Horizon x Rating Bucket + Thickness	81.7%	27	Negligible improvement over model without thickness
Rating + Reinvestment Horizon x Rating Bucket + Flag for [Thickness ≤ 4% & Baa3/below Rating]	83.2%	27	Explains additional 1.6% of variance over model without thickness or DP; <b>chosen model</b>
Rating + Reinvestment Horizon x Rating Bucket + Flag for [Thickness ≤ 4% & Baa3/below Rating] * Rating	84.3%	36	Explains only 1% additional variance with 9 additional variables; potential overfitting for below-IG
Rating + Reinvestment Horizon x Rating Bucket + Flag for [Thickness ≤ 4% & Baa3/below Rating] + Detachment Point Buckets	85.7%	76	Reference point: granular detachment point data only explains an additional 2.5% of variance over chosen model

*Rating modeled as individual indicator variables for each of the 19 ratings*

- American Academy of Actuaries (2025, Sept 8). *C-1 Subcommittee Update on CLO-C1 Factors Modeling [Slides]*. NAIC RBC IRE Public Call.
- American Academy of Actuaries (2025, Dec 15). *C-1 Subcommittee Update on CLO-C1 Factors Modeling [Slides]*. NAIC RBC IRE Public Call.
- S&P, “[Default, Transition, and Recovery: Recovery Study \(U.S.\): Quantitative Easing, Low Yields, And Distressed Exchanges Have Boosted Bond Recoveries Since 2010,](#)” December 14, 2017.

## Questions?

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