# NAIC Collateralized Loan Obligation (CLO) Stress Tests Methodology (Year-End 2020 Update)

### *Introduction*

The NAIC Capital Markets Bureau (CMB) and the Structured Securities Group (SSG) performed a series of stress tests on the CLO holdings of insurance companies. There has been a great deal of regulatory interest in leveraged loans and CLOs as the current credit cycle matures. We ran three scenarios—A, B, and C—with increasing conservatism. The goal has been to measure the potential impact of CLO distress on insurance company balance sheets. This memo lists and describes the assumptions used in our scenarios.

**Please note that these are intended to be stress tests; we have not assigned any probability of occurrence to any of the scenarios described within.**

We welcome regulatory and industry feedback on this project.

### *Stress Thesis*

- Concern about U.S. insurer holdings of CLOs stems from loosened underwriting on the underlying leveraged loans. The loosening underwriting falls into three areas: 1) covenant-lite; 2) absence of subordination; and 3) weaker earnings before interest, taxes, depreciation, and amortizations (EBITDA) multiples.
- Our Stress Thesis is that these developments will result in substantially lower recovery rates on leveraged loans during the next recession. Specifically, we wanted to see how CLOs would perform if the loan recoveries deteriorated from the historical norms to levels comparable with unsecured debt.
- Additionally, we wanted to run our recovery stress in both a historical and a moderately stressful default environment.

### *Scope*

- We endeavored to model all tranches of broadly syndicated loan CLOs held by U.S. insurance companies.
- We tried to exclude:
  - Commercial real estate (CRE) CLOs – The risk is commercial real estate, and different assumptions are required.
  - Re-securitizations, asset-backed securities (ABS) collateralized debt obligations CDOs), and trust preferred securities (TruPS) CDOs – They are out of scope.
  - Middle market CLOs – They are temporarily excluded, as the asset class requires specialized assumptions. We hope to return to these assets shortly.

- Another limitation was the availability of the specific CLO via our third-party software vendor.

### *Default Rate*

- Base data used was Moody's Annual Default Study published in 2021 (Moody's Study).[1]
- We used 10-year cohort data for all cohorts with at least 10 years (1970–2011).
- We calculated an issuer weighted average term structure of default rates for each broad rating category (e.g., Baa, Ba).
  - The default data was sorted into a 40 by 10 cohort (***i***) by tenor (***j***) matrixes $\mathbf{M}_{\mathbf{rating}}$ for each broad category. Eg: $\mathbf{M}_{\mathbf{Baa}}$, $\mathbf{M}_{\mathbf{Ba}}$.
  - A 40-element vector ($\mathbf{n}_{\mathbf{rating}}$) was also created based on the number of defaults in each cohort. Eg: $\mathbf{n}_{\mathbf{Baa}}$, $\mathbf{n}_{\mathbf{Ba}}$, $\mathbf{n}_{\mathbf{B}}$.
  - The weighted default vector ($\mathbf{d}_{\mathbf{rating}}$) for each category was calculated as follows:

$$d_{rating;\,j} = \frac{\sum_{i=1}^{40}(n_{rating;\,i})(M_{rating;i,j})}{\sum_{i=1}^{40}(n_{rating;\,i})}$$

Where i is the cohort and j is the tenor.

- The weighted average standard deviation was also calculated in a similar fashion for each tenor.

$$\sigma_{rating;j} = \sqrt{\frac{\sum_{i=1}^{40}(n_{rating;\,i})(d_{rating;\,j} - M_{rating;i,j})^2}{\sum_{i=1}^{40}(n_{rating;\,i}) - 1}}$$

Where ***i*** is the cohort and ***j*** is the tenor.

- These rating category default rates were scaled by historical ratios (e.g., the ratio of B3 cumulative defaults from Exhibit 44 at year 3 to B defaults from Exhibit 43 is 16.55% / 12.57% = 1.32) to produce rating-specific default vectors.
  - This was done to have a longer dataset (starting in 1970 vs. 1983) and to be able to calculate weighted standard deviations.
- Two default scenarios were used: "Historical" and "Historical + 1σ":

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[1] Moody's, Corporates – Global Annual Default Study: Following a sharp rise in 2020, corporate defaults will drop in 2021, Excel Supplement, 2020.

*Table 1: "Historical" Default Vectors*

| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
|---|---|---|---|---|---|---|---|---|---|---|
| Ba1 | 0.6% | 1.7% | 3.0% | 4.2% | 5.4% | 6.6% | 7.5% | 8.3% | 9.0% | 9.9% |
| Ba2 | 0.9% | 2.2% | 3.7% | 5.2% | 6.8% | 8.1% | 9.3% | 10.6% | 12.1% | 13.6% |
| Ba3 | 1.7% | 4.5% | 7.5% | 10.9% | 13.8% | 16.6% | 19.1% | 21.4% | 23.6% | 25.8% |
| B1 | 2.4% | 6.2% | 10.1% | 13.6% | 17.1% | 20.3% | 23.4% | 26.2% | 28.5% | 30.6% |
| B2 | 3.7% | 9.0% | 14.1% | 18.5% | 22.4% | 26.0% | 28.9% | 31.1% | 33.4% | 35.7% |
| B3 | 5.8% | 12.3% | 18.5% | 23.7% | 28.4% | 32.5% | 36.0% | 39.1% | 41.8% | 44.1% |
| Caa | 12.0% | 21.5% | 28.9% | 34.7% | 39.3% | 43.0% | 46.3% | 49.1% | 51.5% | 53.6% |
| Ca-C | 53.1% | 65.5% | 72.7% | 77.2% | 77.2% | 77.2% | 77.2% | 77.2% | 77.2% | 77.2% |

*Table 2: "Historical + 1σ" Default Vectors*

| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
|---|---|---|---|---|---|---|---|---|---|---|
| Ba1 | 1.1% | 3.3% | 5.3% | 7.1% | 9.0% | 10.6% | 11.6% | 12.4% | 13.2% | 14.0% |
| Ba2 | 1.8% | 4.3% | 6.6% | 8.9% | 11.2% | 12.9% | 14.4% | 16.0% | 17.7% | 19.3% |
| Ba3 | 3.4% | 8.7% | 13.4% | 18.6% | 22.9% | 26.5% | 29.5% | 32.2% | 34.4% | 36.4% |
| B1 | 4.4% | 10.3% | 15.8% | 20.4% | 24.3% | 27.5% | 30.7% | 33.7% | 36.6% | 38.9% |
| B2 | 6.8% | 15.0% | 22.1% | 27.8% | 31.8% | 35.2% | 37.9% | 40.1% | 42.9% | 45.5% |
| B3 | 10.6% | 20.4% | 29.0% | 35.5% | 40.2% | 43.9% | 47.1% | 50.4% | 53.6% | 56.1% |
| Caa | 19.0% | 31.1% | 39.5% | 45.0% | 49.3% | 52.2% | 54.6% | 57.3% | 59.5% | 61.4% |
| Ca-C | 84.0% | 94.8% | 99.3% | 100.0% | 100.0% | 100.0% | 100.0% | 100.0% | 100.0% | 100.0% |

- Certain Ca-C-rating default rates (highlighted in yellow) were adjusted to ensure that marginal defaults rates remained non-negative. We believe that this data artifact was due to scaling so closely to a boundary (100% default).

### *Assigning Default Rates to Underlying Assets*

- The NAIC used Moody's Analytics CDOnet to model the CLO waterfalls. CDOnet publishes the underlying portfolio as reported by the trustee. We used the reported collateral and ratings in our analysis as described below.
- Historical default rates are reported at the **issuer** level, while the debt instrument typically has an **issue** rating, which may be different. The issuer rating is used to calibrate the default rate, while the issue rating influences the recovery rate.
- We used the following logic:
    - If an asset has an **Issuer** rating reported by Moody, Standard & Poor's (S&P), or Fitch, that rating was used to set the applicable default rating.
    - Otherwise, if an asset has an **Issue** rating reported by Moody, S&P, or Fitch, that rating was adjusted to set the applicable default rating as follows:
        - Asset is reported as Senior Secured Loan or Senior Unsecured Bond: default rating = **Issue** rating (consistent with our Stress Thesis)
        - Otherwise: default rating = **Issue** rating + 1 notch (worse)
- Once a default rating has been established, the loan was assumed to "partially default" until its maturity.

- Some portion of the defaulted amount was recovered as described below.

### *Recovery Rate*

- Exhibit 7 of the Moody's Study was used to model recovery rates. Exhibit 7 provides historical recovery rates for nine categories of corporate debt recoveries from first lien bank loan to junior subordinated bond.
  - Please see further discussion of recovery rate selection in the Appendix.
- Our Stress Thesis envisions that underlying leveraged loans will perform like unsecured assets during the next downturn. Furthermore, we assumed that the other assets in the CLO would perform similarly to their next worst category. We call this the "Stepdown" scenario.
- CDOnet provided inputs for three primary debt categories: 1) senior secured loan; 2) second lien loan; and 3) senior unsecured bond. We sought to match the historical rates in Exhibit 7 with categories in our modeling software for both our "Historical" and "Stepdown" scenarios. Additionally, we used the "Other" category as a catchall for any debt not covered by the above three categories.

***Table 3: Mapping Recovery Rates***

| Collateral Label | Historical Priority Position | Stepdown Priority Position | Notes |
|---|---|---|---|
| **Senior Secured Loan** | 1st Lien Bank Loan | Sr. Unsecured Bank Loan | Consistent with our Stress Thesis |
| **Second Lien Loan** | 2nd Lien Bank Loan | Sr. Subordinated Bond | Lowest recovery avail. |
| **Senior Unsecured Bond** | Sr. Unsecured Bond | Subordinated Bond | Consistent with the Stress Thesis |
| **Other** | Jr. Subordinated Bond | Sr. Subordinated Bond | Lowest recovery avail. |

- Recoveries occur six months after default.

### *Scenarios*

- We ran three scenarios named A, B, and C.

***Table 4: Scenarios Run***

| Scenario | Default Rate | Recovery Rate |
|---|---|---|
| **A** | Historical | Historical |
| **B** | Historical | Stepdown |
| **C** | Historical + 1σ | Stepdown |

### *Miscellaneous Assumptions*

- **Interest Rates**
  - Forward London Interbank Offered Rate (LIBOR) curve as of evaluation date
  - Interest on interest (inter-period interest): LIBOR minus 75 basis points (bps)

- **Maturities and prepayments**
  - Non-defaulting portions of each loan mature based on the legal maturity
  - No prepayments were assumed

- **Reinvestment**
  - No post-reinvestment period reinvestment
  - Reinvestment collateral is purchased at par
  - Reinvestment occurs before payment date – i.e., there are no principal proceeds in the waterfall that can be used to pay interest or satisfy overcollateralization (O/C) tests
  - It is assumed to have a rating equal to the transaction's weighted average rating factor (WARF). If the WARF is not reported, then it is assumed to be B3 and is defaulted as stated above.
  - Reinvested collateral is tracked per reinvestment bucket (e.g., all reinvested collateral in June 2021 is tracked separately from collateral reinvested in September 2021).

- **Event timing**
  - Periodic payment on identified collateral – as per loan terms
  - Periodic payment on reinvested collateral – quarterly
  - Collateral defaults on its interest payment date (prior to paying interest or principal)

## *Appendix - Discussion of Modeling*

*Choosing Recovery Rates.*

Moody's presents a number of iterations of historical recovery rates by debt type (Exhibits 7, 9 and 26). We aimed to select the broadest range of data from the perspective of time and asset class. Additionally, we wanted to ensure that the recovery data was available for consistent time horizons.

We chose the data presented in Exhibit 7 - Average corporate debt recovery rates measured by trading prices. This exhibit provided a consistent data set for nine debt positions from 1983 until 2018. While the time frame is shorter than the one we used for defaults, the Moody's Study does not provide the earlier recovery data.

*Trading vs. Ultimate Recovery.*

We used the trading recovery numbers instead of the ultimate recovery numbers (Exhibit 9); the latter are much higher than the former. This was done to align the recovery data with our CLO modeling mechanics. Our current assumption is that there is 6 months between default and recovery – this is more consistent with a trading recovery and typical market modeling assumptions.

Ultimate recoveries occur after a period of time when the company has stabilized and filed for bankruptcy protection. However, for the purposes of modeling CLO performance, this increase in recovery is offset by potential cash flow disruption as the defaulted borrower is no longer paying interest. This, in turn, may trigger the transaction's interest-coverage tests, and the transaction begins de-leveraging. Properly modeling ultimate recoveries is also more complex and requires the introduction of a stochastic variable covering the recovery period.

*Correlations.*

We did not explicitly model portfolio correlations. Each CLO has a unique portfolio which can be diversified across a number of underlying industries. We believe that more advanced correlation modeling is beyond the scope of this project and may overfit the data available to us.

*Manager Choices*

We did not model manager choices due to the difficulty of the task. We may revisit this assumption in the future.

In an actively managed CLO, the manager is allowed to buy and sell assets during a pre-set reinvestment period. There are also limited purchases and sales allowed after the reinvestment period. While some managers can improve the quality of the portfolio, others may make it worse. There are also several ways in which a manager can affect the performance of a CLO.

*First*, the manager may make poor decisions. Historical performance is indicative but no guarantee of future returns. Additionally, considering the dominant position of CLOs in leveraged loan markets, manager trading choices may be a zero-sum game for the CLO market as a whole.

*Second*, a manger may affect the performance of the CLO by undermining the operation of the O/C tests. The O/C tests are defined as the total number of assets over the total liabilities (tranches) at a given point in the capital structure. Often, there are a number of O/C tests conventionally beginning below the single-A tranche. The asset side counts performing loans at par, but defaulted loans are counted at the lower of market price and assumed recovery rate.

As the portfolio experiences defaults, the O/C numerator decreases which may cause the O/C test to breach its test level. A breach acts to divert interest and / or principal to purchase additional collateral (increasing the numerator) or to pay down senior liabilities (decreasing the denominator). These tests provide a substantial amount of subordination and are responsible for CLOs' solid performance to-date.

However, manger actions can undermine this mechanic through "par trading". During the tech bust of the early 2000's, collateralized bond obligation (CBO) managers purchased deeply discounted, but not yet defaulted assets to bolster their struggling O/C ratios. For example, a bond purchased at a $0.50 price which has not yet technically defaulted, would double the impact on the numerator of the O/C ratio. Of course, the bond was trading at a discount for a reason and would quickly default.

In a publication describing the poor performance of the CBO sector, Moody's stated:

> "Much of the portfolio under-performance can be attributed to industry concentration (some managers over-weighted the portfolio in the Telecom industry, which has under-performed significantly) and an "aggressive" investment philosophy. By "aggressive", we refer to the purchase of the cheapest assets for a given rating which, in the recent deteriorating credit environment, resulted in more severe portfolio deterioration." [2]

Subsequently, several changes were introduced into the calculation of the O/C tests to minimize the impact of par trading. However, these are not 'fool proof', and a determined manager can avoid them (albeit for a smaller net impact).

There is financial incentive for the manager to do this; that is, some of the manager's compensation is paid after the payment on all rated tranches and at the same level as the residual tranche. During the tech bubble trading, for example, a manager was able to extract a few extra payments from the CBO. Par-trading is mechanically easy to model but difficult to parametrize.

The actions of the manager are more relevant in Scenarios D and E. The spike in defaults triggers the mechanism of the O/C test earlier, thereby directing more excess interest to pay off outstanding notes. As a result, a number of mezzanine tranches experienced a <u>lower</u> loss in Scenario D than Scenario C

[2] Moody's, U.S. High-Yield CBOs: Analyzing the Performance of A Beleaguered CDO Category, January 31, 2003.

even though the portfolio losses were higher. This change in performance is due to an earlier operation of the O/C test and assumes credit neutral behavior on the part of CLO managers.

*Lastly*, we did not model any potential conflicts of interest between the CLO manager and the private equity owners of the defaulted companies.