MOODY'S
INVESTORS SERVICE

RATING METHODOLOGY

Moody's Approach to Rating TruPS CDOs

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This rating methodology replaces the *Moody's Approach to Rating TruPS CDOs* methodology published in June 2020. We edited references to Libor to clarify that we use the methodology also when assessing transactions with other benchmark references rates. We added a section that mentions our approach to evaluating the risk from environmental, social and governance considerations. We also made limited editorial updates to enhance readability. These updates do not change our methodological approach.

1. Introduction

This report describes our approach to monitoring and rating collateralized debt obligations backed by trust preferred securities (TruPS CDOs). This methodology outlines our modeling assumptions and inputs used in our modeling to assess the credit risk of the rated notes. In all cases, we supplement our quantitative analysis with a range of qualitative considerations to derive our TruPS CDO ratings. Rating committees determine the ratings of TruPS CDO securities, taking into account the unique circumstances and/or characteristics associated with each security.

A majority of the collateral assets in TruPS CDOs we rate are privately issued by small to medium-sized regional banks,[1] insurance firms and real estate investment trusts (REITs). Typically, TruPS are non-amortizing, preferred stock securities with 30-year maturities and five- or ten-year non-call periods. They are deeply subordinated and highly illiquid. Pursuant to their terms, TruPS can defer interest for up to five years, without being considered in default.

2. Types of Collateral Assets in TruPS CDOs

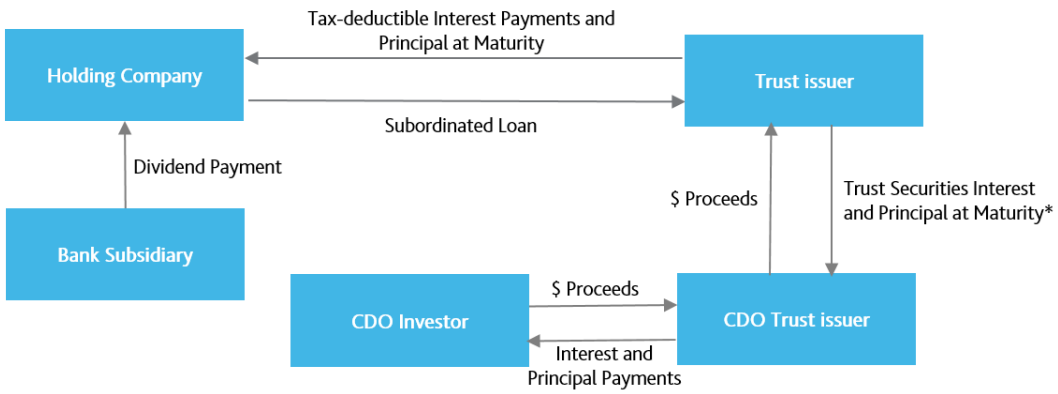
2.1. Bank TruPS

The issuer of TruPS is typically a wholly owned trust subsidiary (the trust issuer) of a bank holding company. The holding company derives its revenues from its operating bank subsidiaries, in the form of dividends and interest.

[1] In this report, references to banks cover thrifts as well, unless otherwise specified.

EXHIBIT 1

Illustration of Relationship between TruPS Issuer and CDO



* The holding company provides a subordinated guarantee to the CDO for the redemption value of the TruPS as well as interest payments.
Source: Moody's Investors Service

As Exhibit 1 shows, the trust issuer issues TruPS, which are purchased for cash by the CDO trust issuer. With the proceeds from the TruPS issuance, the trust issuer purchases deeply subordinated debt from its parent, the holding company. The terms of the indebtedness correspond to those of the TruPS.

The trust issuer uses the tax-deductible interest payments the holding company makes to the trust issuer (pursuant to the terms of the indebtedness) to pay interest to the CDO pursuant to the terms of the TruPS. The holding company guarantees that the trust issuer will ultimately pay the CDO trust issuer any interest and principal payments it receives.

Ultimately, the holding company's bank subsidiaries are the sources of the payments the holding company makes to the trust issuer. A bank's ability to make dividend payments to its holding company is subject to regulation and limitations.

2.2. Insurance TruPS and Surplus Notes

Insurance TruPS have the same characteristics as bank TruPS.

Surplus notes are a highly subordinated form of debt typically issued by insurance companies for regulatory capital. Surplus notes are explicitly subordinate to the insurer's policy claims and indebtedness. Under statutory accounting principles, issuing surplus notes adds to an insurer's net worth or surplus. Surplus notes have characteristics similar to insurance TruPS, but they are typically non-amortizing securities with 10- to 30-year maturities and the non-call period varies by issuer.

2.3. REIT TruPS and Subordinate Notes

There are two main types of REITs that issue TruPS: equity and mortgage REITs. Equity REITs usually invest directly in real estate assets and focus on maximizing the value of their properties and related services. Mortgage REITs manage or originate portfolios of mortgages or mortgage-related securities, including residential mortgage backed securities (RMBS) and commercial mortgage-backed securities (CMBS).[2]

This publication does not announce a credit rating action. For any credit ratings referenced in this publication, please see the ratings tab on the issuer/entity page on www.moodys.com for the most updated credit rating action information and rating history.

[2] For details, see our methodologies for rating residential or commercial mortgage-backed securities. A link to a list of our sector and cross-sector methodologies can be found in the "Moody's Related Publications" section.

Typically, REIT TruPS are non-amortizing securities with 30-year maturities and five- or ten-year non-call periods. Subordinate REIT securities are generally non-amortizing and usually have maturities of 10 or 20 years. Both TruPS and subordinate REIT securities are junior to the senior indebtedness of the REIT.

2.4. Other Collateral Assets in TruPS CDOs

TruPS CDO portfolios could also include, in addition to TruPS securities, collateral such as subordinated and senior debt of banks, insurance firms and REITs. A few transactions also have other TruPS CDO tranches in their collateral portfolio, which we treat in accordance with our Structured Finance CDO Methodology (see the "Moody's Related Publications" section). In addition, REIT TruPS CDOs often have exposure to other mortgage-related assets, including commercial real estate (CRE) CDO and CMBS tranches, in their portfolio.

3. Modeling Approach

3.1. Overview

Below, we describe how we calculate the expected loss (EL) on TruPS CDO tranches and compare it to our benchmarks.[3] The result is a model output which is one consideration of the rating committee. The rating committee considers both quantitative and qualitative considerations in assigning the ratings.

For TruPS CDOs that are either static or no longer permit reinvestment, we model the characteristics of the actual portfolio. For TruPS CDOs in which the collateral manager (Manager) can buy and sell assets subject to covenants in the CDO Indenture, our modeling is generally based on assumptions we derive from the transaction covenants, rather than the CDO's actual portfolio.

3.2. Inputs to the Model

3.2.1. Default Probability

We infer the default probability for each performing collateral asset from our public ratings, adjusted baseline credit assessment (ABCA) or, if unrated, from a credit estimate or Moody's Analytics RiskCalc™ model (RiskCalc) derived credit score. We associate each rating, credit estimate or credit score with a Moody's Rating Factor (Rating Factor),[4] as Exhibit 2 depicts.

[3] For details, see the discussion of Idealized Probabilities of Default and Expected Losses in *Rating Symbols and Definitions.* A link can be found in the "Moody's Related Publications" section.

[4] The Rating Factor represents Moody's Idealized Default Rate for the relevant rating at a 10-year horizon, multiplied by 10,000.

EXHIBIT 2

Moody's Default Probability Ratings[5] vs. Moody's Rating Factors

Moody's Default Probability Rating	Moody's Rating Factor	Moody's Default Probability Rating	Moody's Rating Factor
Aaa	1	Ba1	940
Aa1	10	Ba2	1350
Aa2	20	Ba3	1766
Aa3	40	B1	2220
A1	70	B2	2720
A2	120	B3	3490
A3	180	Caa1	4770
Baa1	260	Caa2	6500
Baa2	360	Caa3	8070
Baa3	610	Ca, C	10000

Source: Moody's Investors Service

With respect to the portfolio's average default probability, the key measure is the Weighted Average Rating Factor (WARF) of the portfolio. In general, the WARF is calculated as the par-weighted average of the rating factors of each of the assets in the portfolio. Similarly, the Weighted Average Life (WAL) of the portfolio is a par-weighted average of the remaining lives of the individual assets. In effect, the WARF, in conjunction with the WAL of the portfolio, is a measure of the average default probability of the assets. If, for example, the WAL of the TruPS CDO portfolio is 20 years and WARF is equal to 940 (associated with Ba1 as per Exhibit 2), the default probability applied to the portfolio is 19.66%.

3.2.1.1. DEFAULT PROBABILITY OF BANK TRUPS ISSUERS

For banks we rate publicly, we use the ABCA to estimate its default probability.

The majority of banks that issue TruPS into a CDO usually have limited access to the capital markets and do not have our public ratings. To determine the default probability of non-publicly rated banks in TruPS CDOs portfolios, we obtain financial data on the banks from the FDIC, calculate key financial ratios and run RiskCalc[6] model to generate credit scores, corresponding to a letter rating equivalent to the ABCA, which we use to derive the portfolio WARF.

We determine the default probability of non-publicly rated bank TruPS in the following way:

1) In most cases, we use the credit cycle adjusted credit scores generated by RiskCalc U.S. Banks model. If a bank has a Texas ratio[7] greater than 100% and a Second Ratio[8] greater than 130%, we assume a Caa2 rating equivalent for the TruPS.

2) In cases where RiskCalc BHC credit scores are unavailable for non-publicly rated banks, we use the operating bank credit score,[9] adjusted or unadjusted depending on the BHC's double leverage ratio given below.

[5] The Moody's Default Probability Rating, which we define here for the purpose of this methodology, should not be confused with the published corporate Probability of Default Rating.

[6] See Moody's Analytics' modeling methodology for RiskCalc U.S. Banks. A link to a list of our sector and cross-sector methodologies can be found in the "Moody's Related Publications" section.

[7] The Texas ratio is the sum of non-current loans and other real estate owned, divided by the sum of tangible common equity and the allowance for loan losses. The lower the Texas ratio, the stronger the bank's financial position.

[8] The Second Ratio is equal to (Non-current loans + other real estate owned + 20% of current construction and development loans)/Tangible common equity + allowance for loan losses).

[9] In the case of a BHC with multiple subsidiaries, the financials of all operating banks are added to get the credit score as if it was a single operating bank.

FORMULA 1

$$\text{Double Leverage Ratio} = \frac{\text{parent holding company assets invested into the equity of subsidiary bank(s)}}{\text{bank holding company equity}}$$

» If the double leverage ratio is less than or equal to 115%, we use the unadjusted operating bank credit score.
» If the double leverage ratio is greater than 115%, we use the operating bank credit score adjusted with the total equity of the BHC.

Source: Moody's Investors Service

3) To account for the inherent limitations of statistical models, the lowest rating factor (corresponding to the highest credit quality) we assume from the RiskCalc model is 360, which translates into an implied default probability rating of Baa2 – that is, we apply a rating cap of Baa2 to the non-publicly rated assets.

We treat the following bank TruPS as defaulted assets and exclude them from the portfolio for the purpose of our WARF calculation:

1) All current defaults as reported by the trustee.

2) All current bank TruPS deferrals, as reported by the trustee, assumed as defaulted unless their issuers satisfy all of the following criteria:
   – a Texas ratio of 50% or lower
   – a Tier 1 capital ratio[10] of 8% or higher; and
   – a credit score[11] mapping to an equivalent letter rating of B3 or higher using the RiskCalc model

3) Vulnerable banks, if they meet either of the following criteria:
   – a Texas ratio greater than 150% and a Second Ratio greater than 175%, or
   – a credit score mapping to an equivalent letter rating of Caa-C.

For TruPS issued by banks that lack a public rating or a credit score from us, we assume a rating factor equivalent to a senior unsecured rating of B3 as long as they are current on their interest payments.

For banks that issue subordinated debt or any other type of debt that will be funded by the CDO, we obtain the adjusted bank's RiskCalc credit score by incorporating pro forma adjustments to the bank's financial statements, as capital structure and credit risk profile of the bank will change upon issuance of the new debt instruments. To make the adjustment, we reduce the BHC equity by the net amount of additional debt issuance.

3.2.1.2. DEFAULT PROBABILITY OF INSURANCE TRUPS ISSUERS

We estimate the default probability of publicly rated insurance TruPS issuers from our senior unsecured ratings. In the absence of a senior unsecured rating, we derive the default probability from the issuer's insurance financial strength rating (IFSR) by adjusting it down by two notches.

For insurance TruPS issuers that we do not rate, we rely on credit estimates based on the credit analysis of the insurance companies' statutory financial statements. For securities issued by insurance companies that lack a Moody's rating or a credit estimate, we assume a rating factor equivalent to a rating of B2 as long as

[10] According to the FDIC, a bank is well capitalized if its Tier 1 capital ratio is equal to or greater than 6%, adequately capitalized if its Tier 1 capital ratio is between 4% and 6%, and undercapitalized if its Tier 1 capital ratio is less than 4%.

[11] A letter rating equivalent to the ABCA.

they are current on their interest payments. This assumed default probability corresponds to the minimum rating of the debt of an insurance company whose interest payments are current.[12]

We exclude all current defaults and deferrals as reported by the trustee from the performing portfolio.

3.2.1.3. DEFAULT PROBABILITY OF REIT TRUPS ISSUERS

We derive the default probability for publicly rated REIT TruPS from our senior unsecured ratings. For REIT securities we do not publicly rate, we rely on credit estimates based on the credit analysis of the underlying REIT firms' statutory financial reports. If no credit estimate is available, we assume the following ratings, depending on the asset type:

EXHIBIT 3

Rating Assumptions for REITs Without Public Ratings or Credit Estimates

Asset Type	Assumed Rating
Mortgage REIT	Caa3
Real Estate Operating Company (REOC)	Caa2
Equity REIT	B3

Source: Moody's Investors Service

These credit estimates or rating assumptions are not public ratings; we use them solely to help model the average default probability of the assets in the TruPS CDO portfolio.

We exclude all current defaults and deferrals as reported by the trustee from the performing portfolio.

3.2.1.4. ADJUSTMENT FOR ASSETS WITH A NEGATIVE OUTLOOK OR ON REVIEW FOR UPGRADE OR DOWNGRADE

We adjust our public ratings for bank, insurance companies and REITs down by one notch, if they have a negative outlook, down by two notches, if they are on review for downgrade, and up by one notch, if they are on review for upgrade. We adjust our public ratings for CDO tranches or other structured finance obligations by two notches if they are on review for downgrade or upgrade. We make an exception for Aaa (sf) structured finance obligations that are on review for downgrade, whereby the downward adjustment is one notch.

3.2.1.5. CREDIT ESTIMATE/CREDIT SCORE STRESSES

For collateral pools with assets where the default probabilities are inferred from, for example, credit estimates, we typically apply various additional stresses.[13] The same stresses applied to credit estimates are also applied to bank credit scores.

3.2.1.6. ADJUSTMENT FOR STRUCTURED FINANCE OBLIGATIONS

A few TruPS CDOs have exposures to other TruPS CDO and structured finance obligations such as CRE CDO and CMBS tranches. Because of the leveraged nature of a CDO, its ratings are sensitive to volatility in the credit performance of the underlying structured finance obligations. To address the impact of this leverage, we apply a stress to the default probability of structured finance obligations in TruPS CDOs, as we describe in our rating methodology for structured finance CDOs.[14]

[12] These assumptions apply only to TruPS issuers that are not domiciled in the US and typically affect a minimal portion of TruPS CDO portfolios.

[13] For details, see our cross-sector methodology describing the usage of credit estimates. A link to a list of our sector and cross-sector methodologies can be found in the "Moody's Related Publications" section.

[14] For details, see our methodology for rating SF CDOs. A link to a list of our sector and cross-sector methodologies can be found in the "Moody's Related Publications" section.

3.2.2. Asset Correlation

3.2.2.1. MEASURING CORRELATION FOR BANK TRUPS

CDOs of bank TruPS are backed by assets from essentially a single industry. In a typical CLO, we compute the diversity score by grouping the collateral assets by industry, and by taking into account the industry-related correlation. However, this traditional measure of diversity could unduly penalize a TruPS CDO, because, even though the issuers are nominally from a single industry, they are somewhat diverse given their regional distribution. The traditional calculation was developed for pools of obligations by larger firms, whose businesses are typically national or international in scope.

In contrast, the small banks that contribute TruPS to CDOs generally operate in a local or, at best, a regional economy. Not surprisingly, the FDIC default data suggest a strong regional pattern to banks that default. Bank default rates correlate significantly to their geographic regions, which suggests that banks' regional diversification could reduce the number of bank defaults in a TruPS CDO portfolio.

To capture both regional diversification, as well as industry-wide correlation in a pool of TruPS, we use an asset correlation framework in which we divide the United States into five major regions, as Exhibit 4 shows. Moody's CDOROM™ (CDOROM), our simulation modeling tool which we use to derive the loss distribution of the collateral pool, incorporates this framework.

EXHIBIT 4

Five Regions for Bank and P&C Insurance Issuers

Region 1	Region 2	Region 3	Region 4	Region 5
Connecticut	Alabama	Arizona	Arkansas	Alaska
Delaware	Illinois	Colorado	Louisiana	California
Florida	Indiana	Idaho	New Mexico	Hawaii
Georgia	Kentucky	Iowa	Oklahoma	Oregon
Maine	Michigan	Kansas	Texas	Washington
Maryland	Mississippi	Minnesota		
Massachusetts	Ohio	Missouri		
New Hampshire	Tennessee	Montana		
New Jersey	Wisconsin	Nebraska		
New York		North Dakota		
North Carolina		Nevada		
Pennsylvania		South Dakota		
Rhode Island		Utah		
South Carolina		Wyoming		
Vermont				
Virginia				
Washington DC				
West Virginia				

Source: Moody's Investors Service

In the asset correlation framework, we make assumptions about the inter- and intra-regional correlation of regional banks. We assume that banks are highly correlated within a region but are less correlated across the five specified regions. Specifically, we assume that the asset correlation is 45% for banks in the same region and 10% for banks in different regions. In addition, we make no distinction between banks and thrifts.

3.2.2.2. MEASURING CORRELATION FOR INSURANCE TRUPS

Like bank TruPS CDOs, insurance TruPS transactions are backed by single-industry collateral pools. We assume that the obligors of insurance TruPS have positive asset correlations, but, because the issuers of

insurance securities are typically small firms, they are less highly correlated than national, multi-line insurance firms.

We assign each Property and Casualty (P&C) insurance TruPS issuer to one of the five geographic regions in Exhibit 4, but we treat Life and Health (L&H) issuers as national in scope; default risk in the P&C business line depends more heavily on geographic location, while default risk in the L&H business line generally does not.

To determine each P&C issuer's location, we calculate the percentage of premiums written in each state and assign each issuer to a region in accordance with the following:

» If the percentage of premiums written for any one state is greater than or equal to 50%, we assume the P&C issuer is located in that state.

» If the percentage of premiums written for each state is less than 50%, we calculate the percentage of premiums written in each of the defined regions. If more than 60% of the premiums written are in one region, we assume the P&C issuer operates in that region.

» We assume that any P&C issuer that does not meet either of the two criteria is diversified (i.e., "national") and assign it to Region 1.

For CDO pools with both bank and insurance obligors, we assume the correlation between P&C and bank issuers in the same region to be 45%. We assume the correlation between P&C insurance and bank issuers in different regions to be 10%. We assume a 10% correlation between L&H issuers and all other insurance and bank issuers, except for super regional banks, with which the correlation is 45% (see Appendix A).

3.2.2.3. MEASURING CORRELATION FOR REIT TRUPS

We estimate correlations for REIT TruPS by first segregating the collateral into the eight sectors we list in Exhibit 5.[15] We further stress the correlation to account for the fact that each of these CDOs is completely backed by real estate-related securities, which can be highly interdependent.[16]

EXHIBIT 5

Moody's Eight REIT Classifications

Commercial REIT – Hotel
Commercial REIT – Multi family
Commercial REIT – Office
Commercial REIT – Retail
Commercial REIT – Industrial
Commercial REIT – Healthcare
Commercial REIT – Self-storage
Commercial REIT – Diversified

Source: Moody's Investors Service

3.2.3. Recovery Rate

We assume a fixed 10% recovery rate in our cash flow analysis for bank, insurance and REIT collateral in default scenarios. This recovery rate takes into account the likelihood that some of the collateral deferring

[15] This classification scheme is the same as the one we use for other multi-sector CDOs we rate and is incorporated into CDOROM. We treat Homebuilders as Buildings and Real Estate, a corporate classification. For residential mortgage REITs, we use our RMBS classifications in CDOROM.

[16] For details, see our methodology for rating SF CDOs. A link to a list of our sector and cross-sector methodologies can be found in the "Moody's Related Publications" section.

interest payments could ultimately pay all of the interest without defaulting. We assume no recovery for any TruPS or subordinated collateral that have already defaulted.

For CDO tranches and other structured finance obligations, we assign the recovery rate based on the rating of the structured finance tranche, as well as additional characteristics of the transaction issuing the obligation.[17]

3.3. Loss Distribution and Expected Loss on the Rated Notes

We incorporate the default and recovery characteristics of the TruPS CDO collateral into a cash flow model that calculates the EL for each rated TruPS CDO liability. The model consists of two primary components: (1) a mechanism for associating collateral loss scenarios with the likelihood that each scenario will occur ("collateral loss distribution") and (2) a cash flow component that relates each collateral loss scenario to the cash flows to the rated liability classes in the scenario. Once we have applied these collateral loss scenarios to the cash flow model, we can calculate the EL for each rated tranche.

The final step is to compare the computed EL for each tranche and its WAL to a set of benchmarks, to determine the model output for the liability.[18] For fast paying tranches, especially senior-most notes with a very short WAL in the case of zero defaults on the underlying collateral, we will also evaluate the outcome of benchmarking the computed EL with other WAL scenarios.

3.3.1. Modeling Collateral Loss Distribution

3.3.1.1. CDOROM SIMULATION FRAMEWORK FOR STATIC TRANSACTIONS

We apply the Monte Carlo simulation framework in CDOROM to model the collateral loss distribution for TruPS CDOs that do not permit reinvestments of collateral. We simulate correlated defaults using a normal (or Gaussian) copula model that incorporates both intra- and inter-correlations as we describe in section 3.2.2. The model simulates losses based on the individual default probabilities from asset ratings and recovery rates and generates loss distributions for use in cash flow modeling.

3.3.1.2. CORRELATED BINOMIAL APPROACH FOR MANAGED CDOS

We apply the correlated binomial expansion technique (CBET) approach for managed TruPS CDOs that have the ability to reinvest. The CBET is a variation on the Binomial Expansion Technique (BET) that we have traditionally applied to cash flow CDO modeling. The BET models a portfolio of idealized assets – identical to and uncorrelated with each other –to mimic the default distribution of the actual collateral pool. Under the CBET, the idealized assets remain identical, but are assumed to be correlated with each other. Compared to the BET, the CBET allows the pool to be represented by a larger number of assets, resulting in more precisely defined loss distribution tails. The single factor that describes the pair-wise asset correlations among the instruments in the collateral pool is Moody's Asset Correlation (MAC).

To produce the best possible fit of the CBET loss distribution to the actual loss distribution of the collateral pool (which reflects the distributions of both defaults and recoveries), we apply a two-step procedure:

1) Simulate loss distribution using CDOROM (as we describe in section 3.3.1.1)
2) Determine the value of the MAC that best fits the simulated loss distribution

[17] Ibid.

[18] For details, see the discussion of Idealized Probabilities of Default and Expected Losses in *Rating Symbols and Definitions.* A link can be found in the "Moody's Related Publications" section.

Once we estimate the MAC, we can use the CBET to associate a probability with each possible collateral loss scenario.

When using the CBET to model the default distribution of the collateral pool, we use a fixed recovery rate equal to the pool's weighted average recovery rate (WARR). The WARR is the par-weighted average of the recovery rate assumptions for the collateral assets described in section 3.2.3.

3.3.2. The Cash Flow Model

Once we have calculated the collateral loss distribution – either through the CDOROM loss distribution for static deals or the CBET approach for managed deals – we associate each collateral loss scenario with the interest and principal on the rated liability classes using a cash flow model. The cash flow model takes into account the following:

- collateral cash flows, including redemption profile
- interest rate hedges
- the priority of payments (waterfall) for interest and principal proceeds received from portfolio assets (as defined in the TruPS CDO Indenture)
- the timing of defaults
- interest-rate scenarios
- reinvestment assumptions (if applicable)
- foreign exchange risk (if present)

We incorporate these features into Moody's Analytics CDOEdge™ software to model cash flows for TruPS CDOs.

3.3.2.1. COLLATERAL CASH FLOWS, INCLUDING REDEMPTION PROFILE

Our cash flow modeling begins with assumptions about the cash flows the collateral pool generates. We associate the modeled interest proceeds and principal proceeds with a particular due period. At the end of each due period, interest proceeds and principal proceeds flow through the interest and principal proceeds waterfalls.

We use the portfolio's weighted average spread (WAS) or weighted average coupon (WAC) to model the interest flows from the CDO assets. Interest proceeds from the floating-rate collateral also reflect an assumed path for Libor/Euribor.[19]

We model principal proceeds from collateral redemptions based on the TruPS' redemption profile. For bank and insurance TruPS, we assume a constant redemption of 5%[20] of the current performing par every year for the life of the transaction or until the last scheduled payment of the assets, whichever is first. Defaults and corresponding recoveries are also part of principal proceeds; we describe how we model these in section 3.2.3.

3.3.2.2. INTEREST RATE HEDGE

TruPS have either fixed or floating rate coupons, while most CDO liabilities have floating rate coupons. In some cases, the TruPS and CDO tranches have hybrid coupons; i.e., they change from floating to fixed at a specified time. To mitigate any interest-rate mismatches between its assets and liabilities, the CDO typically

[19] Note that any references to Libor also apply to other applicable benchmark reference rates, or Euribor.

[20] We may adjust our redemption assumptions depending on market conditions or the specifics of a transaction's collateral portfolio.

enters into one or more multi-year interest rate swaps or caps. Under the terms of the swap, the issuer typically makes fixed-rate payments and receives floating-rate payments based on a fixed swap notional amount. As we do for all CDOs subject to interest rate risk, we test that our ratings are robust across a range of possible interest rate scenarios, as described in section 3.3.2.5.[21]

3.3.2.3. THE PRIORITY OF PAYMENTS

For each rated tranche, we model the cash flows by reflecting the cash flow waterfall specified in the CDO Indenture. Payments can be sequential or *pro rata* and the scheme can vary upon the failure of certain tests. Flows to or from hedge counterparties are included. The modeled waterfall incorporates any over-collateralization (OC) or interest coverage (IC) tests that divert cash flows to more senior classes upon test failure. OC and IC tests are typically cured by first using interest proceeds and then principal proceeds. The waterfall reflects any relevant fees, expenses and accounts as well.

3.3.2.4. THE TIMING OF DEFAULTS

We consider a number of scenarios in which defaults occur during the first eight years of the transaction, with a spike in one of the first six years. The spike is intended to mimic the increase in defaults that could occur in a recession.

Specifically, we assume that 35% of the defaults in a given scenario will occur during the first year, followed by 9.3% of defaults occurring in the following seven years. We then move the 35% default spike through each of the first six years for a total of six eight-year default-timing scenarios. We assign probability weights to each of these six default timing scenarios: 20% for the first profile, 20% for the second, 20% for the third, 20% for the fourth, 10% for the fifth, and 10% for the sixth.

3.3.2.5. INTEREST-RATE SCENARIOS

In our cash flow models, we assume a discrete number of interest rate scenarios to reflect the potential for shifts in short-term rates over time. Specifically, we consider the prevailing forward Libor/Euribor curve as the base case. We also consider one- and two-standard-deviation perturbations to the Libor/Euribor curve, for a total of five interest rate scenarios. That is, we model Libor/Euribor t years into the future as the following:

FORMULA 2

$$L_t = \tilde{L}_t \exp\left\{\omega\sigma\sqrt{t}\right\}$$

Where:

- $\omega \in \{-2, -1, 0, 1, 2\}$,
- $\tilde{L}_t$: represents the forward interest rate curve (such as the Libor or Euribor curve), and
- σ : the annualized volatility of interest rates (such as Libor or Euribor).[22]

Source: Moody's Investors Service

3.3.2.6. REINVESTMENT ASSUMPTIONS (IF APPLICABLE)

When rating a TruPS CDO in which the Manager can buy and sell assets, we derive its portfolio assumptions from the limits defined in the Indenture, such as WAS, WAC and MAC. So long as the Manager can trade in such a way that these collateral quality measures equal their respective limits, we generally examine the

[21] For details, see our approach to assessing counterparty risks in structured finance, including risk related to swap counterparties. A link to a list of our sector and cross-sector methodologies can be found in the "Moody's Related Publications" section.

[22] We determine our assumption of the annualized volatility by reference to observed historical interest rate behavior. Our assumption typically falls in the range of 15% to 20%.

rating implications of assuming that each such collateral quality measure is indeed equal to but no better than its corresponding limit.

For managed TruPS CDOs, when the CDO receives redemption payments and unscheduled proceeds from the collateral pool, or when recoveries occur with respect to defaulted assets (both normally classified as principal proceeds), the proceeds may or may not be reinvested in new collateral. For these CDOs, we will generally assume that reinvestment will take place whenever it is permitted. Thus, for example, if the indenture does not prevent the Manager from reinvesting cash received between the TruPS CDO payment dates, we will model the transaction as if such reinvestments occur immediately.

For managed TruPS CDOs, we mainly apply the CBET approach in conjunction with a cash-flow model, as we describe in section 3.3.1.2.

3.3.3. The Expected Loss Calculation

The expected loss for each tranche is simply the weighted average of losses to each tranche across all the scenarios, where the weight is the likelihood of the scenario occurring.

FORMULA 3

$$EL = \sum_{j=0}^{D} P_j L_j$$

Where:

» P_j : the probability that scenario j will occur, as given by the loss distribution, D is the total number of loss scenarios, and

» L_j : the percentage loss to the tranche in scenario j.

Source: Moody's Investors Service

We define the loss as the shortfall in the present value of cash flows to the tranche relative to the present value of the promised cash flows. Thus,

FORMULA 4

$$L_j = \max(0, \frac{PV_{promised} - PV_j}{PV_{promised}})$$

Source: Moody's Investors Service

We calculate the present values (*PV*s) using the promised tranche coupon rate as the discount rate. For floating rate tranches, the discount rate is based on the promised spread over Libor/Euribor and the assumed Libor/Euribor scenario.[23]

3.3.4. Comparing Expected Losses with Benchmarks

Once we calculate the tranche EL, we associate it with a particular horizon, to compare the EL for a liability tranche to our loss benchmark for that horizon.[24] The relevant horizon is the WAL of the liability tranche in the case of zero defaults on the underlying collateral.

[23] For liability tranches with promised payments that are "off-market" coupons or spreads, or path-dependent promises (including CDO repack notes) we apply our quantitative approach for instruments with non-standard promises as described in Appendix C.

[24] For details, see the discussion of Idealized Probabilities of Default and Expected Losses in *Rating Symbols and Definitions* (a link can be found in the "Moody's Related Publications" section) and in section 7, "Loss Benchmarks."

We consider such model outputs in conjunction with a variety of qualitative factors before the rating committee assigns a rating to a TruPS CDO liability.

In TruPS CDO models, the six default-timing profile and five interest rate scenarios give rise to 30 different EL values for a liability tranche. Regardless of the target rating, a weighted average of the EL calculated for each of the possible scenarios should pass the threshold for the target rating.[25]

3.4. Liability Tranches with Special Characteristics

3.4.1. Instruments that Combine TruPS CDO Secured Debt and Equity

We are sometimes asked to rate instruments that are backed by one or more of the CDO's debt tranches, and sometimes also the equity tranche. Detailed discussions on the quantitative approach to rate these types of securities appear in Appendix C.

3.4.2. TruPS CDO Pass-through Instruments

Some TruPS CDOs may issue instruments that simply pass through all the cash flows of two or more TruPS CDO debt tranches to the holders of the instruments. We analyze such instruments using a weighted average expected loss approach. The analytical approach involves the calculation of the EL for the instrument as the par-weighted average of the components' ELs and its WAL as the par-weighted average of the components' zero-default WALs. We then compare the resulting EL value with the EL benchmark from our Idealized Expected Loss Rates table,[26] based on the instrument's WAL, to determine if the EL results are consistent with the target rating.

3.4.3. Instruments Issued out of Senior/Sub Structures

Some TruPS CDOs may issue instruments that repackage TruPS CDO debt tranches and sometimes TruPS CDO equity ("TruPS CDO repack") out of senior/sub structures. The analytical approach used to analyze these instruments involves modeling the relevant structural waterfall with the cash flows of the underlying TruPS CDO components, as described in section 3. If TruPS CDO equity is included as one of the components, we haircut the cash flows received by the equity, as described in Appendix C.

3.5. Complementary Analysis

We perform a number of complementary analyses in our rating considerations.

3.5.1. Event of Default (EoD) Analysis

In analyzing a TruPS CDO, we assess the likelihood and the potential outcomes of an EoD. If a loss of over-collateralization or failure to pay interest triggers an EoD, we might incorporate this trigger into our modeling analysis prior to the actual occurrence of such an EoD.

The most likely reason a TruPS CDO would trigger an EoD is non-payment of interest on a non-deferrable tranche or a senior coverage test falling below the EoD trigger specified in the indenture. A senior coverage test could fail the EoD trigger because a large number of securities in the portfolio have defaulted or deferred their interest payments. The severity of an EoD depends on the specific remedies in the TruPS CDO indenture. If an EoD occurs, we assume that the controlling class will choose to accelerate cash flows from the performing securities. We also consider the likelihood of the controlling class choosing to liquidate the collateral as a post-EoD remedy. However, this will also depend on the voting requirements for EoD acceleration or liquidation.

[25] The weights we apply to each of the six default-timing scenarios and each of the five interest-rate scenarios are in Appendix B.

[26] For details, see the discussion of Idealized Probabilities of Default and Expected Losses in *Rating Symbols and Definitions.* A link can be found in the "Moody's Related Publications" section.

3.5.2. Sensitivity Analyses

We may also conduct a number of sensitivity analyses of some of the key factors driving the CDO ratings, such as the WARF, WAS/WAC, correlation, WAL and the default timing profile. For example, we model sensitivity scenarios to examine how much rating migration in the underlying assets is necessary to move the rating on the senior most tranche up or down by one notch. We also model downside scenarios; for example, we assume that all deferring banks have defaulted, regardless of whether the banks meet the criteria in section 3.2.1.1.

3.6. Documentation and Legal Opinion Review

Our overall assessment of the legal structure of the TruPS CDO typically includes a review of numerous documents including, as applicable, the Indenture, Collateral Management Agreement, Trust Deed, swap documentation, other transactional agreements, and a number of legal opinions provided by various law firms to the Issuer and the arranger. The typical legal opinions delivered in TruPS CDOs include a general corporate opinion for each party to the transaction, a security interest opinion, an enforceability opinion covering the agreements made by each party to the transaction, and relevant tax opinions. In certain cases, we review additional opinions related to the specifics of a transaction's structure, such as a true sale opinion where there is a close relationship between the seller of the assets and the TruPS CDO.

The legal opinions apply the law of the jurisdiction the parties to the transaction have chosen as the governing law of the transaction documents. Therefore, the opinions do not ask the reader to assume that the law of one jurisdiction is the same as that of any other jurisdiction.

In its review of the TruPS CDO's documents and opinions, we seek to identify any features, ambiguities, or incentives that could result in the TruPS CDO performing in a manner that is not consistent with our rating analysis. Our rating analysis depends on the adequate understanding of the actual functioning of a TruPS CDO, as the legal documentation describes. If the documentation language is vague, we will generally adopt a more conservative reading of the document to ensure that alternative interpretations do not render its analysis inadequate.

4. Transaction Parties

The performance of most TruPS CDOs depends on the ongoing decisions of one or several parties, including the manager and the trustee. Although the impact of these decisions can be mitigated to some extent by a proper alignment of interest with noteholders or by structural constraints, anticipating the quality of these decisions necessarily introduces uncertainty into our assumptions.

5. Environmental, Social and Governance Considerations

Environmental, social and governance (ESG) considerations may affect the ratings of securities backed by TruPS. We evaluate the risk following our cross-sector methodology that describes our general principles for assessing ESG issues[27] and may incorporate it in our analysis.

6. Monitoring

Our approach to monitoring ratings of outstanding TruPS CDO transactions is generally similar to the approach we use to assign ratings, except for those elements of the methodology that become less relevant

[27] A link to a list of our sector and cross-sector methodologies can be found in the "Moody's Related Publications" section.

over time or are not expected to change significantly.[28] Certain components, such as reviews of legal structures of existing transactions or legal opinions, are static and will generally not be re-reviewed unless circumstances warrant. Also, we do not generally update the location of P&C insurance TruPS issuers and use the location determined at the time of the TruPS CDO origination unless the business model of a P&C insurer changes materially. In general, we track the credit performance of the underlying collateral (e.g. potential defaults, significant credit migration), the characteristics of the transactions (e.g. managed versus static), and other, relevant changes in the economic environment of the underlying assets. If performance measures vary materially from initial limits or their prior levels, or the transaction structure changes, we may review the transaction and outstanding ratings in more detail.

7. Loss Benchmarks

In evaluating the model output for TruPS CDO transactions, we select loss benchmarks using the Wide Asymmetric Range, in which the lower-bound of loss consistent with the rating category is given by the Idealized Expected Loss rate[29] associated with the next higher rating category. For initial ratings and upgrade rating actions, the upper-bound of loss consistent with a given rating category is equal to the Idealized Expected Loss rate associated with the given rating category. When monitoring a rating for downgrade, the upper-bound of loss is computed as a 50/50 weighted average on a logarithmic scale. That is, the benchmark boundaries of loss appropriate for evaluating rating category R are given by:

FORMULA 5

$$[1]\ Rating\ Lower\ Bound_R = Idealized\ Expected\ Loss_{R-1}$$
$$[2]\ Initial\ Rating\ Upper\ Bound_R = Idealized\ Expected\ Loss_R$$
$$[3]\ Current\ Rating\ Upper\ Bound_R = exp\{0.5 \cdot log(Idealized\ Expected\ Loss_R) + 0.5 \cdot log(Idealized\ Expected\ Loss_{R+1})\}$$

Where:

- *Rating Lower Bound*$_R$ means the lowest Idealized Expected Loss associated with rating *R* and the expected loss range of rating *R* is inclusive of the *Rating Lower Bound*$_R$;
- *Initial Rating Upper Bound*$_R$ means the highest Idealized Expected Loss associated with rating *R* that is either initially assigned or upgraded and the expected loss range of rating *R* is exclusive of the *Rating Upper Bound*$_R$;
- *Current Rating Upper Bound*$_R$ means the highest Idealized Expected Loss associated with rating *R* that is currently outstanding and the expected loss range of rating *R* is exclusive of the *Rating Upper Bound*$_R$;
- *R-1* means the rating just above *R*;
- *R+1* means the rating just below *R*.
- The Rating Lower Bound for Aaa is 0% and the Rating Upper Bound for C is 100%. These are not derived using the formula.

Source: Moody's Investors Service

[28] For example, in methodologies where models are used, modeling is not relevant when it is determined that (1) a transaction is still revolving and performance has not changed from expectations, or (2) all tranches are at the highest achievable ratings and performance is at or better than expected performance, or (3) key model inputs are viewed as not having materially changed to the extent it would change outputs since the previous time a model was run, or (4) no new relevant information is available such that a model cannot be run in order to inform the rating, or (5) our analysis is limited to asset coverage ratios for transactions with undercollateralized tranches, or (6) a transaction has few remaining performing assets.

[29] For details, see the discussion of Idealized Probabilities of Default and Expected Losses in *Rating Symbols and Definitions.* A link can be found in the "Moody's Related Publications" section.

Appendix A: Correlation Matrix for Bank and Insurance TruPS

EXHIBIT 6

	P&C Region 1	P&C Region 2	P&C Region 3	P&C Region 4	P&C Region 5	L&H	Bank Region 1	Bank Region 2	Bank Region 3	Bank Region 4	Bank Region 5	Super Regional Banks
P&C Region 1	45%	10 %	10 %	10 %	10 %	10 %	45%	10 %	10 %	10 %	10 %	10 %
P&C Region 2	10 %	45%	10 %	10 %	10 %	10 %	10 %	45%	10 %	10 %	10 %	10 %
P&C Region 3	10 %	10%	45%	10 %	10 %	10 %	10 %	10 %	45%	10 %	10 %	10 %
P&C Region 4	10 %	10 %	10%	45%	10 %	10 %	10 %	10 %	10 %	45%	10 %	10 %
P&C Region 5	10 %	10 %	10 %	10 %	45%	10 %	10 %	10 %	10 %	10 %	45%	10 %
L&H	10 %	10 %	10 %	10 %	10 %	45%	10 %	10 %	10 %	10 %	10 %	45%
Bank Region 1	45%	10 %	10 %	10 %	10 %	10 %	45%	10 %	10 %	10 %	10 %	10 %
Bank Region 2	10 %	45%	10 %	10 %	10 %	10 %	10 %	45%	10 %	10 %	10 %	10 %
Bank Region 3	10 %	10 %	45%	10 %	10 %	10 %	10 %	10 %	45%	10 %	10 %	10 %
Bank Region 4	10 %	10 %	10 %	45%	10 %	10 %	10 %	10 %	10 %	45%	10 %	10 %
Bank Region 5	10 %	10 %	10 %	10 %	45%	10 %	10 %	10 %	10 %	10 %	45%	10 %
Super Regional Banks	10 %	10 %	10 %	10 %	10 %	45%	10 %	10 %	10 %	10 %	10 %	45%

Source: Moody's Investors Service

Appendix B: Probability Weights for Moody's Default Timing and Interest Rate Scenarios

We provide the base-case probability weights we use to compute the weighted average expected loss in the table below. If circumstances warrant, we may also examine weighted average EL results given by alternative weightings.

EXHIBIT 7

Bank, Insurance and REIT TruPS CDOs – Libor/Euribor Scenarios

		-2 STD. DEV.	-1 STD. DEV.	FORWARD	+1 STD. DEV.	+2 STD. DEV.	TOTAL
Year of Default Spike	1	1%	4%	10%	4%	1%	20%
	2	1%	4%	10%	4%	1%	20%
	3	1%	4%	10%	4%	1%	20%
	4	1%	4%	10%	4%	1%	20%
	5	0.5%	2%	5%	2%	0.5%	10%
	6	0.5%	2%	5%	2%	0.5%	10%
Totals		**5%**	**20%**	**50%**	**20%**	**5%**	**100%**

Source: Moody's Investors Service

Appendix C: Approach to Rating TruPS CDO instruments that Are Backed by TruPS CDO Secured Debt Tranches and Equity, and TruPS CDO Instruments with Non-Standard Promises

In this appendix, we describe our quantitative approach to evaluating instruments that are backed by one or more CDO tranches, including possibly equity, and our approach to evaluating CDO-related instruments in which the promise to investors is non-standard either because it promises a return of principal only, or because coupons on these instruments correspond to sub-market rates.

Instruments that are Backed by TruPS CDO Debt Tranches and Equity

Securities that are backed by a combination of one or more TruPS CDO tranches and equity are exposed to the risks associated with TruPS CDO equity cash flows and potential refinancing[30] of the TruPS CDO secured debt tranches, if such refinancing is permitted under deal documentation.

Haircuts to Equity Cash Flows

In modeling these instruments, we apply haircuts to the equity cash flows if one of the components is the TruPS CDO equity tranche to address the specific risks associated with TruPS CDO equity.[31] As Exhibit 8 shows, our equity-tranche cash flow haircuts vary with the target rating of the TruPS CDO repack.

EXHIBIT 8

Equity Cash Flow Haircuts by TruPS CDO Repack Rating

TruPS CDO Repack Target Rating	Equity Cash Flow Haircut
Aaa (sf) to Aa3 (sf)	100%
A1 (sf) to A3 (sf)	75%
Baa1 (sf) to Baa3 (sf)	50%
Ba1 (sf) to Ba3 (sf)	25%
B1 (sf) and below	0%

Source: Moody's Investors Service

Refinancing Scenarios

If the deal documentation allows the refinancing of some of the underlying secured debt tranches of the rated instruments, such refinancing can change the instrument's credit risk through the loss of future coupon payments from the refinanced TruPS CDO debt tranches. As such, we include a TruPS CDO refinancing scenario in our analysis to account for the risks associated with potential refinancing of the TruPS CDO secured debt tranches. Adding the refinancing scenario analysis captures the combined effects of missing coupon payments of the refinanced debt tranches as well as the impact on the instrument's WAL/duration.

For TruPS CDOs evaluated at any time between closing and one year after the end of their non-call period, we assume that refinancing occurs one year after the expiration of the non-call period, and we typically assign a 20% probability to the TruPS CDO refinancing scenario. For TruPS CDOs evaluated at any time after the end of this period and up to the end of the reinvestment period, we assume that refinancing occurs at the end of the reinvestment period and we typically assign a 10% probability to the TruPS CDO refinancing scenario. For TruPS CDOs evaluated at any time after the end of the reinvestment period, we

[30] The term refinancing refers to any repayment in full of the TruPS CDO secured debt tranches that takes place much earlier than expected.

[31] We apply these haircuts to address the risks affecting equity cash flows which include expenses exceeding the cap that TruPS CDOs place on the payment of expenses at the top of the payment waterfall, trading losses, and other negative factors. The haircuts described here would also apply when we are asked to rate instruments that represent claims only on the equity tranche

assume that refinancing is unlikely to occur, and thus we typically assign a 0% probability to the occurrence of a TruPS CDO refinancing scenario after the end of the reinvestment period.

We first perform the modeling analysis for a base case assuming no refinancing, by deriving the corresponding weighted average EL and zero-default WAL/duration and obtaining a model output. We then run the refinancing scenario analysis assuming that the instruments receive cash flows before refinancing occurs, their outstanding balance is reduced accordingly, and they receive only equity cash flows (after haircuts) post refinancing. We derive the weighted average EL and zero-default WAL/duration for this refinancing scenario and obtain a model output. We then combine the results of both cases, in accordance with the probabilities discussed above. When the TruPS CDO refinancing scenario is assumed to occur one year after the end of the non-call period, the probabilities assigned to the base case and the refinancing scenario will typically be 80% and 20% respectively. When the TruPS CDO refinancing scenario is assumed to occur at the end of the TruPS CDO reinvestment period, the probabilities assigned to the base case and the refinancing scenario will typically be 90% and 10% respectively. If the TruPS CDO has reached the end of the reinvestment period, we typically assume that the probability of refinancing has been reduced to zero.

Under certain circumstances, we may adjust up or down our assumptions on the probability of a refinancing, in consideration of factors such as market conditions and deal-specific features.

Instruments with Non-Standard Promises

In this section, we describe our quantitative approach to evaluating TruPS CDO-related instruments in which the promise to investors is non-standard either because it promises a return of principal only, or because coupons on these instruments correspond to sub-market rates.

As with TruPS CDO notes with standard promises, our quantitative analysis for instruments with non-standard promises focuses on the EL borne by investors. We generally calculate EL by determining the losses to the noteholders in a series of default scenarios for the underlying collateral and weighting the losses by the likelihood of the scenario occurring.[32] In any scenario, the absolute loss to the noteholders is the difference between the net present value (NPV) of the expected cash flows of the note and the NPV of the promised payments on the note, expressed as a percentage of the promise.

The non-standard promise approach differs from the standard TruPS CDO method in its calculation of loss, discount factor, exposure period and benchmark rate, as we summarize in Exhibit 9. We use this approach to analyze combo notes and TruPS CDO repacks.

EXHIBIT 9

Comparison of Non-Standard Promise and TruPS CDO Approaches

	Non-Standard Promise	TruPS CDO
Promise	Path-dependent promise	Par
Loss (%)	(Promise – NPV CF[33]) / Promise	(Par – NPV CF) / Par
Discount Factor	Risk-free rate (or a nearly risk-free rate, such as Libor)	Coupon
Exposure Period	Probability weighted duration	Weighted average life (zero default scenario)
Benchmark	Dynamic benchmark rate	Moody's Idealized Expected Loss rates[34]

Source: Moody's Investors Service

[32] For a full discussion of the modeling approach for TruPS CDOs, see section 3.

[33] NPV CF refers to the net present value of all cash flows.

[34] For details, see the discussion of Idealized Probabilities of Default and Expected Losses in *Rating Symbols and Definitions.* A link can be found in the "Moody's Related Publications" section.

Quantitative Analysis - Step-by-Step Approach

Our approach to modeling non-standard promise instruments entails the following steps:

1) Generate cash flows to the combo/repack note, for each default scenario
2) Calculate the NPV of cash flows using a (usually Libor-based) risk-free rate as the discount factor for each default scenario
3) Determine the promised cash flows by summing up the NPV of cash flows and unpaid interest and principal, for each default scenario
4) Calculate loss and duration, for each default scenario
5) Calculate the EL and expected duration by weighting the various default scenarios by their probabilities of occurrence
6) Compare the EL of the TruPS CDO combo/repack note to that of the benchmark bond with a similar duration, to derive an appropriate rating

Step 1: Generate cash flows

We generate cash flows as described in section 3.3.2. In each default scenario, we allocate the cash flow to the combo/repack note according to the note structure.

Step 2: Calculate the net present value (NPV) for each default scenario

For each default scenario, we calculate the NPV of all of the cash flows, discounting each cash flow using Libor/the risk-free rate:

FORMULA 6

$$NPV\ CF = \sum_{t=1}^{m} CF_t * DF_t$$

Where:

» CF_t refers to the cash flows during the period t;
» DF_t refers to discount factor at time t; and
» m refers to maturity.

Source: Moody's Investors Service

Step 3: Determine the promise for each default scenario

In analyzing a TruPS CDO combo note or repackaged security, we calculate the promise which is path-dependent and varies in each default scenario, as described in the following equation

FORMULA 7

$$Promise = NPV\ CF + NPV\ Unpaid\ Interest\ and\ Principal\ when\ Due$$

Where:

» NPV Unpaid Interest and Principal when Due = (PIK Balance[35]+ Principal Loss) * Discount Factor at Maturity[36]

Source: Moody's Investors Service

Step 4: Calculate loss and duration for each default scenario

Under each default scenario, total loss is simply the shortfall in the NPV of cash flows relative to the promise and equal to the NPV of unpaid interest and principal when due. The loss rate is the ratio of the total loss to the promise.

FORMULA 8

$$Loss\ \% = \frac{(Promise - NPV\ CF)}{Promise}$$

The duration (***Dur***) is that of promised, not actual, cash payments:

$$Dur = \frac{(\sum_{t=1}^{m} DF_t * CF_t * t) + DF_m * (PIK\ Balance + Principal\ Loss) * m}{(\sum_{t=1}^{m} DF_t * CF_t) + DF_m * (PIK\ Balance + Principal\ Loss)}$$

Source: Moody's Investors Service

The PIK Balance in this equation applies only to TruPS CDO combo/repacks that can defer interest payments.

Step 5: Calculate expected loss and expected duration

We calculate the ***EL*** and expected duration (***ED***) as the probability-weighted loss and duration, across all of the default scenarios using the following formulas.

FORMULA 9

$$EL = \sum_{i=0}^{D} Loss_i\% * P_i$$

$$ED = \sum_{i=0}^{D} Duration_i * P_i$$

Where:

» *D* refers to the number of default scenarios and P_i refers to the probability associated with each default scenario.

Source: Moody's Investors Service

Step 6: Compare the EL of the TruPS CDO combo/repack to that of a same-duration benchmark bond

We derive the rating on the note by matching its EL to that of an appropriate benchmark bond with the same duration (as we describe in Exhibit 11). We calculate the EL hurdle rate of the benchmark bond based on a number of inputs: rating, duration, the risk-free rate curve, recovery rate and payment frequency. We adjust our benchmarks to reflect the discounting used to compute the EL of a note with a non-standard promise. Whereas ELs for standard promise notes are calculated using the coupon of the note (which generally includes a credit spread on top of the risk-free rate), ELs for non-standard promise notes use the

[35] Some of these debt instruments can defer interest payments if there is a cash flow shortfall. The unpaid interest, which accrues interest, is called PIK Balance.

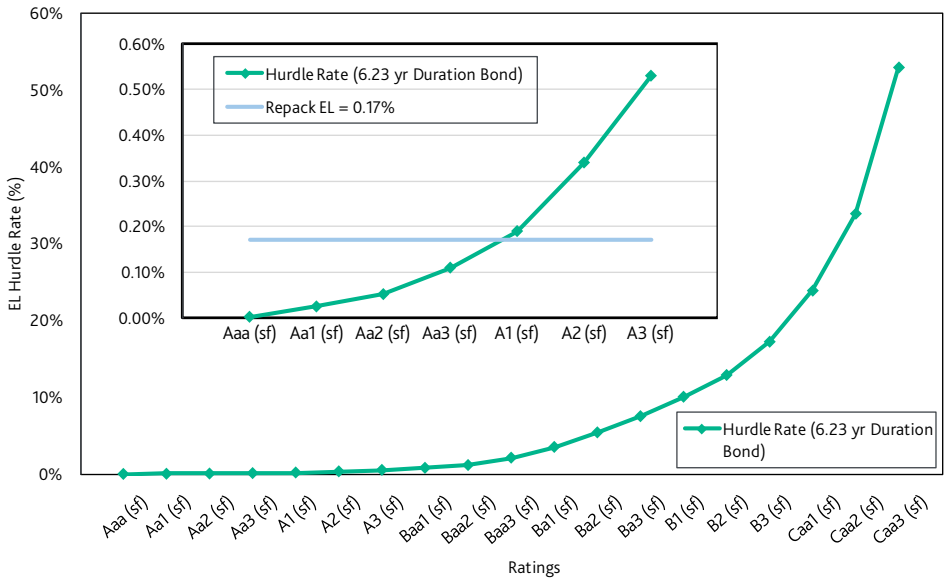
[36] We allow for the possibility that the TruPS CDO Repack note is PIKable and principal is not due until maturity. Therefore, the *Promise = NPV CF + PV Unpaid Interest and Principal at Maturity* and only the discount factor at maturity is necessary for the second half of the calculation. If the note were not PIKable, we would use the present value of the unpaid interest for each period using the appropriate discount factors for the relevant periods.

risk-free rate. The use of the risk-free discount factor necessitates an adjustment to our usual EL benchmarks.[37]

Exhibit 10 shows the procedure for a note with an EL of 0.17% and an expected duration of 6.23 years.

EXHIBIT 10

Comparison of the EL of the TruPS CDO Combo/Repack to the EL Hurdle of the Benchmark Bond



Source: Moody's Investors Service

[37] While we use the loss boundaries as described in section 7 of this report, we select loss benchmarks as set forth in Exhibit 11.

EXHIBIT 11

Deriving the Hurdle Rate of the Benchmark Bond

By definition, the benchmark par bond's non-arbitrage price equals its par value. For simplicity, we assume that the bond's par value is equal to 1. In general, we calculate the price of the benchmark par bond as:

$$Par = \sum_{t=1}^{N} PV(CFs(t) \mid default\ in\ time\ period\ t) * Prob(default\ in\ time\ period\ t) + PV(All\ Promised\ CFs(N) \mid no\ default) * Prob(survival\ in\ time\ [0,N])$$

Where:

- *PV* = the present value
- *CFs(t)* : all cash flows received in time periods *1* to *t*
- *PV(CFs(t) | default in time t)* : the present value of all cash flows received from time period *1* to *t* given that the bond has experienced a default in time *t*
- *Prob(ℰ)* : the probability that event *ℰ* has occurred.

For a general case considering default risk in the expected cash flow payments, the price of the bond can be expressed as:

$$Price = \sum_{t=1}^{N} [S_t(f_t + s) + d_t r]F_t + S_N F_N$$

Where:

- D_t : cumulative probability of default for time *t*
- d_t : probability of default in period *t* (survival through period *t - 1* and default in period *t*) = $D_t - D_{t-1}$
- r : recovery rate (constant)
- f_t : risk free rate in period *t*
- s : credit spread (constant)
- F_t : discount factor for period *t* (calculated using the risk-free rate)
- S_t : probability of survival (no default) through period $t = 1 - D_t$
- N : total number of time periods

Assuming the bond is priced at par, we can solve for the default-implied credit spread, ***s***:

$$s = \frac{1 - \sum_{t=1}^{N}[S_t f_t + d_t r]F_t - S_N F_N}{\sum_{t=1}^{N} S_t F_t}$$

We use the default-implied credit spread to calculate the present value of the benchmark bond promise, ***PV(Promise)***:*

$$PV(Promise) = \sum_{t=1}^{N} (f_t + s)F_t + F_N$$

Thus, we derive the benchmark par bond expected loss and expected duration using the following formulas:

$$EL(\%) = \frac{PV(Promise) - 1}{PV(Promise)}$$

$$Expected\ Duration = \frac{\sum_{t=1}^{N}(f_t + s)tF_t + NF_N}{PV(Promise)}$$

* The promise for the benchmark bonds is not path-dependent, because they are conventional (non-PIKable) bullet bonds: It is exactly the discounted value of the promised coupons plus the discounted par amount at maturity.

Moody's Related Publications

Credit ratings are primarily determined through the application of sector credit rating methodologies. Certain broad methodological considerations (described in one or more cross-sector rating methodologies) may also be relevant to the determination of credit ratings of issuers and instruments. A list of sector and cross-sector credit rating methodologies can be found here.

For data summarizing the historical robustness and predictive power of credit ratings, please click here.

For further information, please refer to *Rating Symbols and Definitions*, which includes a discussion of Moody's Idealized Probabilities of Default and Expected Losses, and is available here.

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