MOODY'S
INVESTORS SERVICE

RATING METHODOLOGY

Corporate Synthetic CDOs Methodology

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This rating methodology replaces *Moody's Approach to Rating Corporate Synthetic Collateralized Debt Obligations* published in July 2019. The methodology's title and table of contents have been revised. We have also made limited editorial updates to improve readability, and we have added a footnote for further transparency on our approach to monitoring transactions. The updates do not change the substantive approach of the methodology.

Scope

This methodology describes our approach to rating corporate synthetic collateralized debt obligations (CSOs).[1] It details our assumptions and approach to analyzing key credit risks in CSOs and explains how we analyze those risks in the context of the structure of a transaction.

[1] We may also use this methodology, or some of its analytical components, to rate non-synthetic securitizations backed by bonds or loans.

Rating Approach

Asset Overview

CSOs Description

CSOs may be differentiated by a number of characteristics:

» Balance Sheet vs. Arbitrage

» Static vs. Managed

» Funded vs. Unfunded

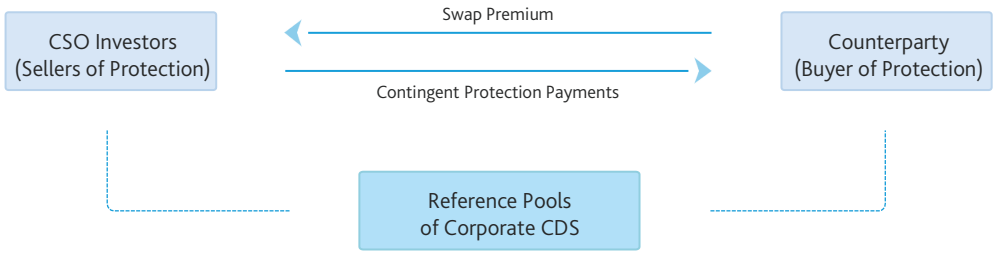
The first distinction, balance sheet vs. arbitrage, addresses the impetus behind the issuance of a CSO. Balance sheet transactions are designed to synthetically hedge against credit exposures retained by the bank without actually removing the assets from its balance sheet. In contrast, arbitrage transactions are free of such a requirement.

The distinction between a managed and static CSO typically indicates the extent to which a reference portfolio changes throughout the transaction's life. Managed transactions employ a manager who actively trades assets in the reference portfolio. Static portfolios have reference portfolios that generally do not change, except through credit events or cancellations.[2]

Finally, synthetic CDOs may be funded or unfunded. Unfunded transactions are simple credit default swaps between the protection buyer and the protection seller, as depicted in Exhibit 1:

EXHIBIT 1

Illustration of a Typical Unfunded Corporate CSO



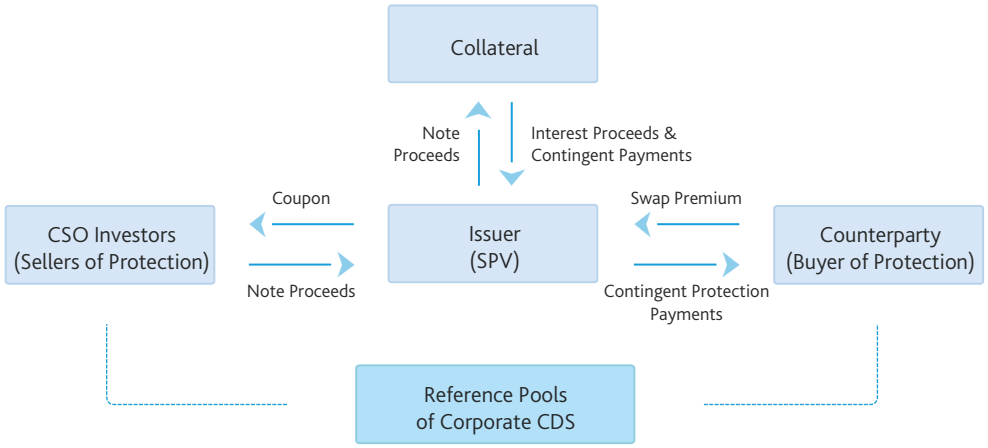
Source: Moody's Investors Service

In a funded CSO, there is typically a special purpose vehicle (SPV) that issues notes. The proceeds from the notes purchased by the investors are normally invested in highly rated collateral. The SPV also enters into a credit default swap (CDS) with the swap counterparty acting as the protection buyer from the SPV. Interest payments to investors are drawn from interest payments received on the collateral and premium received under the CDS. In the case of a credit event, the collateral is sold or delivered in kind to make contingent payments under the CDS. At the transaction's maturity, all collateral not used to make contingent payments is returned to investors as principal (see Exhibit 2 below).

[2] There are static transactions that allow for substitutions and/or removals at the behest of the investor.

EXHIBIT 2

Illustration of a Typical Funded Corporate CSO



Source: Moody's Investors Service

Managed CSOs

Typical managed cash-flow CSOs entail a large number of covenants designed to limit the collateral manager's ability to impose additional risks on the holders of rated notes. Typical covenants related to the portfolio would include minimum collateral quality characteristics as well as portfolio concentration limits. The covenants are a practical alternative to the modeling of expected losses (EL) prior to each portfolio substitution, which could be quite cumbersome in the cash-flow context.

Because plain-vanilla CSOs are easily modeled using Moody's CDOROM™ ("CDOROM"), most managers choose to test prospective trade compliance via CDOROM itself, rather than managing via an elaborate set of covenants. That is, they run on a pro-forma basis to determine that the EL posed to investors in rated tranches, as modeled by CDOROM, will not deteriorate below their trading limit, however defined, as a result of the trade.

We take account of the manager's obligation to test potential trades against the CDOROM modeled EL. Thus, the many covenants that govern trading decisions within a typical cash-flow CDO are effectively replaced by a single covenant to avoid a deterioration in tranche EL levels, as measured by CDOROM, that would violate the trading criteria as defined under the CSO documentation's terms.[3]

Finally, it is important to emphasize that CDOROM is a static model in the sense that it does not consider future changes in the portfolio as a result of the manager's decision. Depending on the transaction, the level of trading flexibility can be based either on a "maintain or improve" standard or based on the manager's discretion within some limit. As part of the trading criteria assessment, we consider the alignment of the manager's long-term interests with the ultimate repayment of principal and all accrued interest to the investors in the rated tranches.

[3] In that context, CDOROM is used as a tool for producing modeled expected losses (or modeled Moody's Metrics) for the purpose of a test embedded in the transaction documentation. It should not be viewed as an indicator of the actual rating outcome assigned to the notes.

Analytical Overview

When rating CSOs, we typically address the expected credit loss borne by investors relative to the promise. We use a simulation framework to model losses in reference pools of mostly investment-grade corporate credits. Our modeling parameters are based on historical corporate default and recovery data from 1920 to 2011, a period that covers both the 1929 Great Depression and the 2008-09 financial crisis.

The framework and assumptions we present here are embedded in CDOROM.

The methodology also discusses other risks that we consider in rating a CSO, including counterparty risk, the key documentation issues of a tax event upon merger, large quotation amounts, consideration of the roles of key transaction parties, and the monitoring of outstanding transactions and ratings.

In all cases, we supplement our quantitative analysis with a range of qualitative considerations to derive our CSO ratings. Rating committees determine the ratings of CSO securities,[4] taking into account the unique circumstances and/or characteristics associated with each security. As such, the assigned ratings may differ from the model output.

Asset-level Analysis and Related Modeling

Overview of Expected Losses Modeling Framework

Losses within the pool are modeled based on a standard single-period multi-factor Gaussian copula model using Monte Carlo simulations of (1) defaults (through correlated asset values), and (2) recovery rates (correlated and following a beta distribution).

Correlated Asset Values and Reference Credit Defaults Modeling

Default Event

Default events are simulated through correlated asset values following a standard multi-factor Gaussian copula framework. Each reference entity's default probability is a function of its rating and its maturity. The default probability values are derived from our Idealized Default Probabilities table.[5] For example, for a reference entity rated A2 with a five-year maturity, the default probability is 0.4670%.[6]

Correlation Framework

We model pair-wise asset correlations between reference credits with values that are based on (1) the reference entity's credit rating, (2) its industry classification, and (3) its country of domicile. In our model, correlations are broken into two components: (a) the inter-industry (or "global") correlation reflects the dependency between references irrespective of their industry or region and is based on the reference entity's ratings and (b) the intra-industry correlation reflects additional dependency between reference entities if they are in the same industry and/or region. All else being equal, two reference assets in the same industry and region will have higher intra-correlation values than two reference assets in different industries and/or regions.

We apply a three-point probability distribution to the inter-industry correlation to represent three separate states of low, medium and high correlations. This reflects the historical default patterns observed dating back to the 1920s and allows us to better match losses in the tail of the distribution. We assume correlations vary with the reference assets' credit ratings.

[4] The ratings assigned to obligations assessed under this credit rating methodology will carry the (sf) indicator. For more information, see *Rating Symbols and Definitions*. A link can be found in the "Moody's Related Publications" section.

[5] For more information, 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 the "Loss Benchmarks" section.

[6] Additional stresses may be applied, such as for soft credit events, and as a result the default probability that is used in modeling may be higher.

We vary our intra-industry correlations with the nature of the industry in which the pair of reference entities operate. Specifically, we designate each industry as either "local," "semi-local" or "global." For global industries, reference assets in the same industry and the same region have the same intra-industry correlation as reference assets in the same industry, but different regions.

We model exposures to different obligations or entities within the same corporate family with 100% asset correlation.

Random Recovery Rates Modeling

Unless the recovery rate associated with a credit event is specified as fixed in the CSO documentation, we simulate correlated stochastic recovery rates that each follow univariate beta distributions. The values for the means and standard deviations depend on the credit type, for example, bond vs. loan, or secured vs. unsecured. We assume recovery rates to be correlated and model exposures from the same corporate family as having 100% correlation between their recovery rate processes. We model recovery rate correlation using a single factor Gaussian copula.

Modeling Assumptions

Reference Entity Default Probability

We base our modeled default probability on the reference entity's rating, following the rating algorithm we describe below. This approach allows us to derive default probabilities at the issuer level and conforms with our view that the same probability of default applies to all of an issuer's obligations. For modeling purposes, we may adjust these ratings according to outlook or review status, and/or other modifications.

Asset-level Default Probabilities

The following describes our approach to deriving the reference assets' default probabilities:

- For all corporate credits, we will use:
  - the corporate family rating (CFR),[7] otherwise
  - the rating we have assigned to senior unsecured debt of the obligor (SU), otherwise
  - the rating we have assigned to senior secured debt of the obligor (SS) notched down by one notch.
- For corporate credits in the financial industry, we may consider:
  - long-term deposit rating or adjusted BCA, possibly adjusted to better reflect reference entity default risk
  - insurance financial strength rating (IFSR), notched down by one notch
- For all other corporate credits we may also consider:
  - short-term rating; if rated P-1, apply a rating of A2; if P-2, apply a rating of Baa2, and if rated P-3, apply a rating of Baa3
- Absent application of any of the above steps, we use a credit estimate (CE).[8]

[7] Absent a CFR for the obligor, we may use the CFR of an entity within the same corporate family.

[8] For more information, see the discussion of credit estimates in *Rating Symbols and Definitions* and our cross-sector methodology that discusses the usage of credit estimates in our rating analysis. A link to a list of our sector and cross-sector methodologies can be found in the "Moody's Related Publication" section.

Asset-level Default Probability Adjustments

REFERENCES UNDER REVIEW OR WITH NEGATIVE OUTLOOK

Our research shows that instruments under review for possible upgrade or downgrade have lower (or higher) default probabilities than similarly rated instruments that are not under review. To reflect this, we adjust reference asset ratings within our CSO models as follows:

» We adjust credits under review for possible downgrade down by two notches

» We adjust credits under review for possible upgrade up by one notch.

» We adjust credits with negative outlook down by one notch

ADVERSE SELECTION

CSO portfolios are exposed to adverse selection of reference credits. As a result, we incorporate an additional default probability adjustment for adverse selection of single-name credits and credits in over-concentrated industries that is based on Market Implied Ratings (MIRs).[9] MIRs provide credit risk and relative value signals based on market information, including CDS spreads.

» For the industry with the largest exposure in the portfolio, as well as any industry with a concentration over 15%, the default probability of each credit within that industry is increased by the equivalent of:

FORMULA 1

$$OC\ adjustment = one\ notch + 2 * abs(min(0, MIR\ gap\ for\ OC\ industries))$$

Where:

» OC = over-concentration in the portfolio

» ABS = absolute value

Source: Moody's Investors Service

» For credits other than those in over-concentrated industries, we will increase the default probability by the equivalent of:[10]

FORMULA 2

$$Non\text{-}OC\ adjustment = abs(min(0, MIR\ gap\ for\ non\text{-}OC\ industries))$$

Where:

» OC = over-concentration in the portfolio

» ABS = absolute value

Source: Moody's Investors Service

We will assess individually any credits with particularly wide gaps between their fundamental ratings and the corresponding MIRs, and any portfolios with unusually large concentrations in any one industry.

[9] Adverse selection adjustments are expressed in terms of notches, with negative gap values corresponding to MIRs that are lower rated than the corresponding relevant Moody's rating. Credits with positive gaps are included in the calculation of the adjustments, but the non-over concentrated industry and over-concentrated industry average gaps are capped at zero.

[10] To clarify, each credit will be subject to either the non-over concentrated industries or over-concentrated industries adjustment, but not both. The calculation of the non-over concentrated industries adjustment excludes references in over-concentrated industries. For certain portfolios that are over-concentrated but not as a result of credit adverse selection, a different stress may be applied.

CREDIT EVENT STRESS

The definition of a credit event in CSO documentation does not necessarily correspond to our definition of defaults; thus, we apply a "soft" credit event default probability stress in rating CSOs to address this potential discrepancy. For example, a CSO might define as a credit event a restructuring that is not considered a default under our rating definition. The soft credit event default probability stresses range between 5% and 25% based on region and the type of restructuring.[11]

Asset Correlation

We assume the following inter-industry asset correlation in our modeling:

- For investment-grade credits, inter-industry correlations are {5%, 10%, 20%} with weights equal to {70%, 20%, 10%}, respectively.
- For Ba-rated credits, inter-industry correlation are {3%, 9%, 12%} with weights equal to {70%, 20%, 10%}, respectively.
- For B-rated credits and below, inter-industry correlation are {3%, 7%, 10%} with weights equal to {70%, 20%, 10%}, respectively.[12]

For the purpose of assigning intra-industry asset correlations, we designate each industry as "global," "semi-local" or "local" to describe the extent to which credits within a single industry are correlated. Regional distinction will matter more for "local" industries than for "semi-local" industries. If an industry is "global," then the regional distinction does not matter. Exhibit 5 of Appendix A lists the designation of each industry. The intra-industry asset correlations are additive to the inter-industry correlations. We apply the correlation "add-on" factors as follows:

- For references in different regions and the same industries that are designated as "local," we apply no additional correlation.
- For references in different regions and the same industries that are designated as "semi-local," we apply an add-on of 6%.
- For references in different regions and the same industries that are designated as "global," we apply an add-on of 12%.
- For references in the same region and same industries, we apply an add-on of 12%.

Recovery Rates

Assumed Mean and Standard Deviation Values by Asset Type

We base our recovery rate assumptions on our historical analysis of corporate bond defaults, as measured by trading prices 30 days post-default. We simulate stochastic recovery rates following a beta distribution with means and standard deviations given in Exhibit 3.

[11] See Exhibit 4 in Appendix A for the specific stress level we apply to each credit definition.

[12] Portfolios comprising mostly B-rated credits will be subject to evaluation under our BET model for cash-flow CLOs. For more information, see our methodology that describes our approach to rating collateralized loan obligations. A link to a list of our sector and cross-sector methodologies can be found in the "Moody's Related Publications" section.

EXHIBIT 3

Mean and Standard Deviation Assumptions by Asset Type, Seniority and Security

Asset Type/Seniority/Security	Mean	Standard Deviation
Senior secured loans (first-lien only)	60%	25%
Senior secured loans (non-first lien) and senior secured bonds	45%	30%
Senior unsecured bonds and senior unsecured loans	35%	30%
Subordinated bonds	25%	25%

Source: Moody's Investors Service

Cheapest-to-Deliver Haircut

CSOs typically define credit events for reference entities, rather than specific assets, but do specify a set of criteria for the assets eligible for the valuation of the loss; hence, the protection seller can choose, within a basket of eligible assets, the cheapest-to-deliver asset for each defaulting reference entity. As a result, the realized recovery values in CSOs could be lower than those used to calibrate our modeling parameters. Based on our comparison of the difference between recoveries on ISDA credit events against the trading prices of bonds 30-days post default, we apply a cheapest-to-deliver recovery haircut of 10% for all assets.

Structural Analysis and Liability Modeling

Overview

Once we calculate losses within the reference pool, we pass these through the CSO structure to determine whether there are any losses to the rated tranches. The average of such losses across all simulation scenarios is our modeled expected loss.

Expected Loss Calculation

Average Loss Percentage in Present Value

The modeled EL for each rated tranche is the average loss across all simulated scenarios.[13] We define a loss for a particular scenario as the proportionate shortfall in the value of the payments to the investor in the scenario relative to the value of the payments expected by the investor at the time of the transaction's inception. The discount rate used is the current swap rate plus the spread on the tranche.

EL Benchmark Comparisons

Our Idealized Expected Loss rates represent the benchmark ELs associated with each rating category over various time horizons.[14] We assess the model output by comparing the instrument's calculated EL and weighted average life (WAL) to these benchmarks.

For plain-vanilla CSOs, we calculate the WAL by assuming zero defaults in the reference pool and a bullet amortization of the reference assets at their respective WALs. Thus for a simple five-year CSO, the WAL for a single liability tranche would equal five years. In general, if the reference pool has different WALs, we calculate the tranche WAL within our model based on the reference pool amortization profile as well as the capital structure of the CSO.

[13] Since the EL for CSOs is based on a simulation process, the convergence of the simulation will depend, in part, on the number of iterations chosen. We apply a 99% confidence interval adjustment to the EL result using a standard error equal to the square root of the EL variance divided by the number of Monte Carlo simulations. If this confidence interval adjustment is significant, a larger number of iterations may be used to reduce the standard error.

[14] For more information, 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 the "Loss Benchmarks" section.

Loss Benchmarks

In evaluating the model output for CSO transactions, we select the loss benchmark referencing the Idealized Expected Loss table[15] 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 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 3

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

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 $Rating\ Upper\ Bound_R$.

» $R\text{-}1$ 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

Other Considerations

Collateral Risk in Fully or Partially Funded CSOs

In fully or partially funded CSOs, the proceeds of the notes are invested in collateral as set forth in the CSO indenture. Collateral serves three specific purposes in funded synthetic transactions. First, the remaining proceeds in the collateral account are used to repay principal on the notes at maturity or at the transaction's termination. Second, the interest income generated by the collateral may pay, either in full or in part, the interest on the synthetic notes issued to investors. Last, collateral is used to secure the obligations of the protection seller or SPV on payments due from the occurrence of credit events or floating amount events.

[15] For more information, 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.

Funded synthetic transactions may expose investors to three primary types of collateral risk: (1) credit risk, (2) liquidation risk, and (3) basis risk. We incorporate these elements into our rating analysis by either (a) assessing the impact through quantitative modeling, or (b) evaluating the efficacy of structural mitigants incorporated into transaction documentation.

Collateral Credit Risk

The investors' principal may be at risk if the collateral defaults;[16] however, the severity may be greater than simply the loss on the collateral itself. In most synthetic trades, the collateral's default is an event of default under the CDS, with the protection seller as the defaulting party. A termination payment may be due from one party to the other depending on the mark-to-market (MTM) valuation of the CDS. If the MTM is "in the money" to the protection buyer, the collateral's recovery value is generally used to make this payment as a first priority. Once the termination payment is paid to the counterparty, there may not be sufficient proceeds to repay the investor. The loss associated with a senior-ranking termination payment is generally a function of the market's perception of the portfolio's credit drift and the transaction's remaining tenor, and may exceed our estimation of the protections payments that would otherwise have become payable by the issuer. If, for any transaction, there were a material likelihood that the issuer would be required to make a material senior termination payment following collateral default, we would likely cap the transaction's rating to the collateral's rating.

Collateral Credit and Liquidation Risk

A minority of transactions seek to de-link collateral credit risk by inserting triggers in their documentation whereby the collateral must be replaced at no cost to the investor or CSO upon a downgrade of the collateral below a certain level. Further, upon the collateral's liquidation at either maturity or early termination, the proceeds may be less than the collateral's par value because of illiquidity or market value decline.[17]

Basis Risk

Basis risk arises when there is a mismatch of payment dates or interest rates between the assets and liabilities. CSOs may be exposed to basis risk if the collateral is based on different indices or are of different payment frequency than the notes. Hedging contracts such as asset swaps, basis swaps or total return swaps have been used to reduce the collateral's basis risk. These contracts may stipulate that the counterparty in the hedge agreement pays either the cost of funds rate or a fixed rate on the specified payment dates in exchange for the interest proceeds from the collateral asset. Generally, a requirement that the SPV passes through the proceeds from the collateral is a stronger mitigant than paying a specified amount in case the collateral asset is replaced.

Counterparty Risk

We model counterparty risk associated with any derivative agreement, including the CDS counterparty, as additional EL in the manner we described above for the treatment of collateral risk; i.e., we take into consideration the expected loss to the CSO as a result of the counterparty defaulting.

If the associated loss is limited to the loss of premium from the CDS counterparty, then we model the additional EL as the default probability of the counterparty multiplied by the loss of accrued premium.

In funded CSOs, a counterparty's default may also result in a senior-ranking termination payment that is payable by the issuer. We determine the likelihood of such a payment for each transaction in view of all relevant factors, including (1) the rating and domicile of the counterparty; and (2) the existence and

[16] We may add the expected loss associated with the collateral to the expected loss of the tranche modeled on an unfunded basis (i.e., based primarily on the risks generated by the reference entities/obligations).

[17] For more information, see our cross-sector methodology that describes our approach for assessing counterparty risks in structured finance, including account bank and investments related risks. A link to a list of our sector and cross-sector methodologies can be found in the "Moody's Related Publications" section.

enforceability of the priority of payments (including a "flip clause" by which payments to the counterparty are to be subordinated following counterparty default). The loss associated with a senior-ranking termination payment is generally a function of the market's perception of the portfolio's credit drift and the transaction's remaining tenor, and may exceed our estimation of the protection payments that would otherwise have become payable by the issuer. If, for any transaction, there were a material likelihood that the issuer would be required to make a material senior termination payment following counterparty default, we would likely cap the transaction's rating to the counterparty's rating as described in the "Collateral Credit Risk" section.

In most cases, parties to the transaction have incorporated structural features into the derivative agreements to mitigate counterparty risk. These are typically in the form of rating downgrade trigger provisions requiring the counterparty to take some action (e.g., collateralize, replace itself, or obtain a guarantee) when the counterparty does not meet the minimum counterparty rating requirement. Our analysis of such structural features takes into consideration among other factors, the nature of the exposure to the counterparty, the potential for credit migration, as well as the type of derivative agreement.

Tax Event Upon Merger (TEUM)

Tax Event Upon Merger (TEUM) is a termination event in the 1992 and 2002 ISDA Master Agreements that arises when one party to a swap merges and due to withholding tax, causing losses to one or more parties. The CSO may thereby be negatively affected by this merger. CSOs may face 1) withholding tax risk and 2) risk of loss due to early termination of the transaction. A TEUM event that is not neutralized may limit the maximum achievable rating of a CSO. We discuss these risks and methods in the sections below.

Withholding Tax Risk

If the protection buyer in a CSO merges, the deal may be required to make a greater (gross) payment or receive a lesser (net) payment as a result of the withholding tax.

If the protection buyer grosses-up its payments without qualification and the deal is not required to gross-up its payments, then the risk is mitigated.

The ISDA standard gross-up clause does not provide an unqualified obligation to gross-up. In particular, it says that no gross-up is required if:

» the withholding tax is not an "Indemnifiable Tax,"[18] or

» the deal's Payee Tax Representation is false (other than due to change of law).[19]

If the protection buyer does not gross-up its payments without qualification or the deal is required to gross-up, tax risk associated with counterparty merger can nonetheless be mitigated if the deal can terminate the swap to prevent losses. It will only be able to do so if TEUM applies as a termination event in its favor.

Early Termination of Transaction Risk

If the swap is terminated due to TEUM, it is likely that the rated transaction will terminate as well, and may expose the deal to liquidation risk from the collateral securing the notes.

[18] Indemnifiable Taxes are those imposed in respect of payments under the swap, and exclude those which are imposed "due to a present or former connection between the jurisdiction of the government or taxation authority imposing such tax and the recipient of such payment or a person related to such recipient".

[19] Section 2(d)(i)(4) of the ISDA Master Agreement.

Additionally, any termination payment should be subordinate to payments on rated debt to ensure that rated debtholders do not suffer a loss due to the Protection Buyer's merger.[20] All or part of the risks outlined above may apply to any CSO, depending on the structure.

Quotation Amount

Using large quotation amounts in the valuation of cash-settled CDS has a materially negative impact on the reference entity's liquidity. We observed that this risk may be mitigated by either of the two options below.

» Incorporate the following three structural mechanisms in the valuation process to mitigate illiquidity concerns:

- Maximum quotation amount of $20 million per valuation date (including all valuation obligations of a reference entity valued on that date). This amount can be larger if different sets of dealers are used on the same valuation date; for example, a $40 million reference entity can be valued on a single valuation date, provided that $20 million is brought to one set of five dealers and $20 million is shown to a second set of five dealers.
- A waiting period of three to five business days between valuation dates.
- For each valuation date, at least two of the dealers are different from those used on the preceding valuation date; however, any set of five dealers can be used again on non-consecutive valuation dates.

Apply the final price from the valuation of a portion of the reference entity notional amount, which is less than or equal to $20 million, to the entire notional amount of the reference entity.

The alternative is to model the risk arising from excessive quotation amounts. We may, for example, apply a recovery rate haircut absent any contractual mitigants to quotation-size risk. The size of the additional haircut will vary depending on the size of the quotation amount.

Manager and Trustee Assessment

The Manager

Our assessment of the manager's potential impact on the CSO's performance includes an evaluation of the managing firm itself (often incorporating an on-site operations review) and by considering the documents that define the manager's role for the proposed CSO.[21]

The Trustee

The trustee has a number of responsibilities and plays an important role in the CSO's overall structure. Its role is critical under special circumstances, for instance in an event of default and upon an early redemption.

Typically, one of the trustee's responsibilities is to report on compliance of a managed CSO with the Moody's model test criteria within CDOROM. Alternatively, an accounting firm or other responsible third party could perform this function.

We ask to receive copies of any written notices provided to any party pursuant to the underlying documentation. These would include, in addition to notices of any amendments to the underlying

[20] See the "Counterparty Risk" section above for how we assess the risk of losses associated with senior-ranking termination payments.

[21] The management agreement includes a description of the manager's duties with respect to the CSO. Some of the key elements of this agreement address the standards of care and liability, the conditions governing the manager's termination, and the provisions for dealing on an arm's length basis.

documentation, any redemption of the notes. We also ask to review a pro forma monthly report to ensure it includes sufficient information for our surveillance purposes.

Monitoring

We generally apply the key components of the approach described in this report when monitoring transactions, except for those elements of the methodology that could be less relevant over time, such as certain legal or structural elements.

Generally, when monitoring the performance of static or managed CSO transactions, we track the credit performance of the underlying reference entities (e.g., potential credit events or significant credit migration) and any changes in the credit environment that could impact future performance. Within our surveillance process, we would typically consider an upgrade if the EL on the rated obligation has improved to the benchmark associated with a higher rating than the outstanding rating. We will generally consider a rating downgrade if the EL on the rated obligation exceeds the upper limit of the range associated with the outstanding rating. This approach allows for expected short-term performance variations from period to period without resulting in excessive rating volatility.

In addition, we use qualitative judgment to determine whether the EL on the rated obligation has indeed reached the upper or lower limit and may take a rating action in expectation of a significant performance trend. This judgment may include forward-looking considerations beyond those captured in the modeling framework.[22]

We incorporate current information in our monitoring analysis. In addition to periodic notices and reports sent by the parties to the transaction (such as the Trustee), additional information may be required.[23] A material change in any transaction feature or performance prompts a reassessment of the transaction.

[22] 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.

[23] For more information, see our cross-sector methodology that describes our global structured finance data quality evaluation. A link to a list of our sector and cross-sector methodologies can be found in the "Moody's Related Publications" section.

Appendix A: Reference Tables

EXHIBIT 4

Credit Event Stresses

Credit Event Type	Restructuring	MHO	RML	Obligation Acceleration (OA)	Sovereign	Bonds Only	DP Stress Applied
Corp-MR	TRUE	TRUE	TRUE				5%
Corp-MMR	TRUE	TRUE	TRUE				5%
Corp-OR+MHO	TRUE	TRUE					5%
Corp-OR	TRUE						12.5%
Corp-NoR							0%
Corp-MR+OA	TRUE	TRUE	TRUE	TRUE			17.5%
Corp-MMR+OA	TRUE	TRUE	TRUE	TRUE			17.5%
Corp-OR+MHO+OA	TRUE	TRUE		TRUE			17.5%
Corp-OR+OA	TRUE			TRUE			25%
Corp-NoR+OA							0%
Sov-MR	TRUE	TRUE	TRUE		TRUE		5%
Sov-MMR	TRUE	TRUE	TRUE		TRUE		5%
Sov-OR+MHO	TRUE	TRUE			TRUE		5%
Sov-OR	TRUE				TRUE		12.5%
Sov-NoR					TRUE		0%
Sov-OR+MHO+BO	TRUE	TRUE			TRUE	TRUE	5%
Sov-OR+BO	TRUE				TRUE	TRUE	5%
ProjFin-DistSales							0%
ProjFin-NonDistR							0%
ProjFin-DistSales+NonDistR							0%
ABS-Liq-3month							0%
ABS-Liq-6month							0%
ABS-Liq-1year							0%
ABS-Liq-2years							0%
ABS-Iliq-3month							0%
ABS-Iliq-6month							0%
ABS-Iliq-1year							0%
ABS-Iliq-2years							0%
Corp-MR-DigCDSStress	TRUE	TRUE	TRUE				10%
Corp-MMR-DigCDSStress	TRUE	TRUE	TRUE				10%
Corp-OR+MHO-DigCDSStress	TRUE	TRUE					10%
Corp-OR-DigCDSStress	TRUE						25%
Corp-NoR-DigCDSStress							0%
Corp-MR+OA-DigCDSStress	TRUE	TRUE	TRUE	TRUE			35%
Corp-MMR+OA-DigCDSStress	TRUE	TRUE	TRUE	TRUE			35%
Corp-OR+MHO+OA-DigCDSStress	TRUE	TRUE		TRUE			35%
Corp-OR+OA-DigCDSStress	TRUE			TRUE			50%
Corp-NoR+OA-DigCDSStress							0%
Sov-MR-DigCDSStress	TRUE	TRUE	TRUE		TRUE		10%
Sov-MMR-DigCDSStress	TRUE	TRUE	TRUE		TRUE		10%
Sov-OR+MHO-DigCDSStress	TRUE	TRUE			TRUE		10%
Sov-OR-DigCDSStress	TRUE				TRUE		25%
Sov-NoR-DigCDSStress					TRUE		0%
Sov-OR+MHO+BO-DigCDSStress	TRUE	TRUE			TRUE	TRUE	10%
Sov-OR+BO-DigCDSStress	TRUE				TRUE	TRUE	10%
N/A							0%

Source: Moody's Investors Service

EXHIBIT 5

Industry Classification and Intra-industry Correlation Designation

For the purpose of CSO analysis, the Banking, Finance, Insurance and Real Estate industries are consolidated into one industry.

Moody's Sector Code	Sector Name	Global/ Local Classification
101	Aerospace & Defense	Global
102	Automotive	Global
103	Banking	Global
104	Beverage, Food & Tobacco	Semi-Local
105	Capital Equipment	Semi-Local
106	Chemicals, Plastics, & Rubber	Global
107	Construction & Building	Semi-Local
108	Consumer goods: Durable	Semi-Local
109	Consumer goods: Non-durable	Semi-Local
110	Containers, Packaging & Glass	Semi-Local
111	Energy: Electricity	Semi-Local
112	Energy: Oil & Gas	Global
113	Environmental Industries	Local
103	FIRE: Finance	Global
103	FIRE: Insurance	Global
103	FIRE: Real Estate	Global
117	Forest Products & Paper	Semi-Local
118	Healthcare & Pharmaceuticals	Semi-Local
119	High Tech Industries	Global
120	Hotel, Gaming & Leisure	Semi-Local
121	Media: Advertising, Printing & Publishing	Semi-Local
122	Media: Broadcasting & Subscription	Semi-Local
123	Media: Diversified & Production	Global
124	Metals & Mining	Global
125	Retail	Semi-Local
126	Services: Business	Semi-Local
127	Services: Consumer	Semi-Local
128	Sovereign & Public Finance	Local
129	Telecommunications	Global
130	Transportation: Cargo	Semi-Local
131	Transportation: Consumer	Semi-Local
132	Utilities: Electric	Local
133	Utilities: Oil & Gas	Local
134	Utilities: Water	Local
135	Wholesale	Semi-Local

Source: Moody's Investors Service

EXHIBIT 6

Intra-correlation Add-on

	If in the same Industry , but different Regions (ρ^I)	If in the same Industry and same Region (ρ^R)
Global	+12%	+0%
Semi-Local	+6%	+6%
Local	+0%	+12%

Source: Moody's Investors Service

EXHIBIT 7

Classification of Countries by Contagion Region

Asia	Central America & The Caribbean	Eastern Europe & Former Soviet Union	Europe	Indian Subcontinent	Middle East & North Africa	North America	South Africa	South America	Sub-Saharan Africa
Australia	Antigua and Barbuda	Afghanistan	Aland Islands	Bangladesh	Algeria	American Samoa	Botswana	Argentina	Angola
Brunei	Aruba	Albania	Andorra	Bhutan	Bahrain	Antarctica	Lesotho	Bolivia	Benin
Cambodia	Belize	Armenia	Anguilla	British Indian Ocean Territory	Egypt	Bahamas	South Africa	Brazil	Burkina Faso
China	Bonaire	Azerbaijan	Austria	India	Iran	Barbados	Swaziland	Chile	Burundi
Christmas Island	British Virgin Islands	Belarus	Belgium	Maldives	Iraq	Bermuda		Colombia	Cameroon
Cocos (Keeling) Islands	Costa Rica	Bosnia	Bouvet Island	Nepal	Jordan	Canada		Ecuador	Cape Verde
Cook Islands	Cuba	Bosnia and Herzegovina	Bulgaria	Pakistan	Kuwait	Cayman Islands		Falkland Islands	Central African Republic
Fiji	Curacao	Georgia	Croatia	Sri Lanka	Lebanon	Dominican Republic		Paraguay	Chad
Guam	Dominica	Macedonia	Cyprus		Libyan Arab Jamahiriya	Greenland		Peru	Comoros
Heard Island and McDonald Islands	El Salvador	Moldova	Czech Republic		Libya	Jamaica		South Georgia	Congo
Hong Kong	Grenada	Russia	Denmark		Morocco	Mexico		Suriname	Cote D'ivoire
Indonesia	Guatemala	Russian Federation	Estonia		Oman	Puerto Rico		Uruguay	Djibouti
Japan	Haiti	Serbia and Montenegro	Euromarket		Palestinian Territory	Saint Pierre and Miquelon		Venezuela	Equatorial Guinea
Kiribati	Honduras	Turkey	Eurozone		Qatar	United States			Eritrea
Korea, Democratic People's Republic of	Montserrat	Ukraine	Faroe Islands		Saudi Arabia	United States Minor Outlying Islands			Ethiopia
Korea, Republic of	Netherlands Antilles	Kazakhstan	Finland		Somalia	US Virgin Islands			Gabon
Laos	Nicaragua	Kyrgyzstan	France		Sudan				Gambia
Macao	Panama	Tajikistan	French Guiana		Syria				Ghana
Malaysia	Saint Kitts and Nevis	Turkmenistan	French Polynesia		Tunisia				Guinea
Marshall Islands	Saint Lucia	Uzbekistan	Germany		United Arab Emirates				Guinea-Bissau
Micronesia	Saint Vincent and the Grenadines		Gibraltar		Yemen				Kenya
Mongolia	Trinidad and Tobago		Greece						Liberia
Myanmar	Turks and Caicos Islands		Guadeloupe						Madagascar
Nauru			Guyana						Malawi
New Caledonia			Hungary						Mali
New Zealand			Iceland						Mauritania
Niue			Ireland						Mauritius
Norfolk Island			Isle of Man						Mozambique

EXHIBIT 7

Classification of Countries by Contagion Region

Asia	Central America & The Caribbean	Eastern Europe & Former Soviet Union	Europe	Indian Subcontinent	Middle East & North Africa	North America	South Africa	South America	Sub-Saharan Africa
Northern Mariana Islands			Israel						Namibia
Palau			Italy						Niger
Papua New Guinea			Latvia						Nigeria
Philippines			Liechtenstein						Rwanda
Samoa			Lithuania						Sao Tome and Principe
Singapore			Luxembourg						Senegal
Solomon Islands			Malta						Sierra Leone
Taiwan			Martinique						Tanzania
Thailand			Mayotte						Togo
Timor-Leste			Monaco						Uganda
Tokelau			Netherlands						Western Sahara
Tonga			Norway						Zambia
Tuvalu			Pitcairn						Zimbabwe
Vanuatu			Poland						
Vietnam			Portugal						
Wallis and Futuna			Reunion						
			Romania						
			Saint Helena						
			San Marino						
			Seychelles						
			Slovakia						
			Slovenia						
			Spain						
			Svalbard and Jan Mayen						
			Sweden						
			Switzerland						
			United Kingdom						
			Vatican City State						

Source: Moody's Investors Service

Appendix B: Approach to Modeling Structured Finance Transactions Backed by Corporate Credits with Country Risk

In this appendix, we describe our approach to assessing structured finance transactions backed by a corporate portfolio with exposure to country risk[24] and a weighted average portfolio rating of Ba3 or better. The framework applies to transactions backed by corporate obligors domiciled in countries with a foreign currency ceiling[25] (FCC) of Aa1 or lower and for which we derive the default (or loss) distribution of the collateral pool via simulation. The approach entails a two-step process, in which we first simulate a country ceiling event for each of the obligors in the portfolio and then estimate the impact of such an event on the obligors.

Two-Step Approach to Modeling Country Risk

Our two-step approach to modeling country risk entails the following:

» Simulating the occurrence of a country ceiling event for all of the countries represented in the collateral pool, reflecting our FCCs as well as our sovereign correlation assumptions.

» Depending on the outcome of our simulation,

  – if a country ceiling event does occur, assuming that all the obligors in that country will default with the same recovery rate as in the no-country-ceiling event case

  – if a country ceiling event does not occur, simulating corporate defaults for obligors domiciled in that country using our standard corporate default and recovery assumptions in the CSO methodology.

In the first step, we consider only country risk. In the second, we incorporate corporate asset correlations for pairs of credits.

For portfolios highly concentrated in a single country or region, we might also conduct additional analysis to supplement the current framework.

Step 1: Country Ceiling Event Modeling

Probability of a Country Ceiling Event

In the first step, we simulate the correlated probability of a country ceiling event occurring for each country in which any of the pool obligors is domiciled, using CDOROM software.[26] We infer the probability from the country's FCC, which reflects risks arising from political, institutional, financial and economic factors either inside or outside the country. It also reflects the risk that the domestic currency will no longer be convertible into a foreign currency. We simulate the country ceiling event only for countries with an FCC of Aa1 or lower.[27]

Asset Correlation

We incorporate default correlations through the modeling of asset correlations. These asset correlations depend on the region in which each country is located.

[24] The risk affecting a given country that arises from (a) political, institutional, financial and economic factors either inside or outside the country, and (b) the transfer of and conversion into foreign currency. For more information, see our cross-sector methodology for assessing local currency country risk ceilings. A link to a list of our sector and cross-sector methodologies can be found in the "Moody's Related Publications" section.

[25] For assets that are free of both transfer and convertibility risk, we might use the local currency ceiling rather than the FCC. All references to country ceilings are bond ceilings.

[26] We have incorporated the country ceiling event modeling parameters into CDOROM.

[27] The approach we describe here does not apply to corporate obligors whose ratings pierce their sovereign ceilings, nor to supranational entities.

We assume a 1% global asset correlation for obligors in different regions. For pairs of countries in a single region, we assume a substantially higher asset correlation of 25%. Countries in the same region could have a mutual dependence on external capital flows, on commodity prices, or on political regimes that could have spillover effects into neighboring countries. Our higher asset correlation assumption for pairs of countries in a single region reflects these dependencies. We define 10 such "contagion regions."

- Europe[28]
- Eastern Europe & Former Soviet Union
- Middle East & North Africa
- Sub-Saharan Africa
- South Africa
- Indian Subcontinent
- Asia
- North America
- Central America & the Caribbean
- South America

Step 2: Corporate Default Modeling

Case A: Country Ceiling Event Occurs

We assume that should a country ceiling event occur, all the obligors in the affected country will default.

Case B: No Country Ceiling Event Occurs

For obligors domiciled in countries for which we have not simulated a country ceiling event, our treatment is identical to that for any corporate entity in a CSO. Hence, we assume no direct correlation between corporate defaults in one country and a country ceiling event in another, although the two will correlate indirectly through the sovereigns.

DEFAULT PROBABILITY AND ASSET CORRELATION

In our standard corporate approach, we infer default probability for corporate entities from the corporate family rating (CFR) and the tenor of the exposure, using our idealized default probability table.[29] However, since we already account in Case A for the portion of default probability that arises from the potential country ceiling events, in Case B we consider only the default probability that arises from idiosyncratic corporate risk. This default probability is the conditional default probability knowing that no country ceiling event has occurred. It is calculated so that the final default probability (i.e. the probability to default due to a country ceiling event plus the probability to default absent of a country ceiling event) equals the CFR implied default probability.[30]

[28] In cases where there is a currency union, such as the eurozone, we may consider alternate correlation assumptions, such as those applied in our approach to rating collateralized loan obligations. For more information, see our methodology that describes our approach to rating collateralized debt obligations. A link to a list of our sector and cross-sector methodologies can be found in the "Moody's Related Publications" section.

[29] When no CFR is available, we use alternative ratings or estimates, as described in the "Reference Entity Default Probability" section. We also adjust public ratings to reflect their outlook or review status, as described in the same section.

[30] Hence, we do not model country ceiling events for assets with ratings higher than their FCCs.

Asset correlations among corporate credits depend primarily on industry, but also on the country of domicile and the obligor's rating. We classify industries as "local," "semi-local" or "global," to determine the relationship between the country of domicile and the asset correlation.[31]

RECOVERY RATES

We simulate recovery rates following a beta distribution with mean and standard deviation values given in Exhibit 3 and assume that recovery rates vary by type of obligation. For each given type, we use the same recovery rate assumptions for all obligors, regardless of the nature of the simulated country ceiling event and region of the obligor. We assume a common set of recovery rates across all regions, because actual recovery rates for both North American and emerging market defaulted obligors have differed very little. Our corporate analysts expect that, even for the types of obligations for which the amount of historical data is limited, recovery rate distributions are unlikely to vary by region. For synthetic transactions, cheapest-to-deliver recovery haircuts may be applied, depending on the credit events used in the transaction documentation. In these cases, the cheapest-to-deliver haircut level is 10%, consistent with standard CSOs.

Finally, we apply the same recovery assumptions for sovereign and corporate bond recovery rates.

Concentrated Pools

The method described in this appendix assumes a certain degree of geographical diversification in the collateral pool. For portfolios with significant single country sub-Aaa exposures, we may conduct additional analysis when assigning ratings.

Such factors considered include the maximum exposure to any single sub-Aaa country. Based on the exposure amount, we may vary the level of loss severity assumptions applied upon the occurrence of a country ceiling event. For example, given a portfolio concentrated with asset types expected to be significantly impacted by the macroeconomic or financial distress of a single sub-Aaa country, the minimum credit enhancement level commensurate with a Aaa rating may be equivalent to the maximum exposure size of the respective sub-Aaa country.

[31] For more information, see the "Asset Correlation" section.

Appendix C: Approach to Mapping Ratings and Scores Provided by Third-Party Entities

Overview

In this appendix, we describe our approach for mapping ratings and scores from third-party entities, such as banks and specialized rating or score providers, to our rating factors. We map third-party ratings for unrated assets included in e.g. certain collateralized loan obligations (CLOs) such as balance sheet CLOs or transactions backed by loans to small- and medium-sized enterprises (SME). Our mapping approach incorporates both qualitative and quantitative elements and is determined and periodically reviewed by rating committees.

A mapping is a correspondence between a third-party rating category (or class) and our rating factor as per our Idealized Cumulative Default Rates. The rating factor that results from the mapping allows us to associate a default probability with an asset that does not have a Moody's rating or a credit estimate. Rating factors are not equivalent to and do not represent traditional Moody's credit ratings. If we conducted an analysis commensurate with a full credit rating, the result may be significantly different.

Furthermore, we may seek a credit estimate for any unrated individual asset that accounts for more than approximately 3% of the portfolio, rather than using a mapping for the asset.

Qualitative Analysis

Our qualitative mapping analysis determines whether we can achieve a mapping that is sufficiently reliable for use in a transaction. We cover the key qualitative elements of the rating system during an operational review. More specifically, our operational review of the third party[32] includes an assessment of the entity's rating system methodology and associated processes, including the credit approval process, credit and loan personnel and systems. We also review the independence of its ratings assignments from its processes for both loan origination and the selection of assets for inclusion in the structured finance transaction.

Operational Review

During the operational review, we seek to understand the expertise and experience of the individuals who are responsible for assigning the ratings, the adequacy of staffing levels at the rating provider, and detailed information on the third-party rating process. If the rating provider is a bank, we also obtain an overview of its loan underwriting standards. The operational review also includes a discussion of the roles of the rating provider's relevant staff, any models, methodologies and systems involved and the set of procedures applicable to the assignment of an internal rating.

We will also seek information related to the rating provider's monitoring process, including the standard frequency of review of ratings, the circumstances which may prompt an unscheduled review and the placement of credits 'on watch' for further attention. Another factor we consider is the stability of the rating process itself.

Finally, we will review whether the rating provider is regulated and the applicable regulations governing the provider. If regulated, we will assess the frequency and extent to which the provider's ratings process is audited by an internal audit function and evaluated by an external regulator(s). Both the frequency of such reviews and the findings are relevant. For a bank's rating system, an important aspect is whether it has been approved for the advanced approach under the Basel II framework (or any subsequent revision thereof). We consider mappings of these types of rating systems to be generally more reliable because of: (1) the close

[32] When the rating is provided by a specialized provider, the operational review will cover the specialized provider with respect e.g. to the rating system methodology and rating assignment process and the originator with respect e.g. to the use of the ratings.

scrutiny bank regulators apply to assess a bank's internal credit processes, and (2) their acknowledged experience and expertise in assessing the credit risk of their customers and counterparties. Strong bank supervision and implementation of robust risk management processes greatly increase the likelihood that a bank will maintain consistent credit policies across time, as well as across borrowers in different regions and sectors.

If we expect that the entity's rating system is not sufficiently complete or robust, we may apply more conservative assumptions or adjustments when determining a mapping or we may conclude that a mapping process is not feasible.

Quantitative Analysis

In general, to determine the correspondence between a third party's rating and Moody's rating factor, two approaches are possible:

1) If the rating provider's overall portfolio contains a sufficiently large sample of borrowers with monitored Moody's ratings and the sample is representative of the securitized portfolio, we perform a statistical analysis, comparing the third-party ratings to Moody's monitored ratings.[33] We call this the *rating matching approach*.

2) If the rating provider's overall portfolio contains an insufficient sample of borrowers with monitored Moody's ratings, we establish a mapping by comparing

    a) The long-run average probabilities of default ("target PDs") assigned to each rating grade within the provider's rating system to our Idealized Default Rates of the same time horizon; or

    b) If the third party's rating system does not include target PDs, the performance (e.g. historical default rates) of the provider's rating system with the performance of Moody's monitored ratings over a similar time horizon.

Mapping approach 2.a. may be complemented by an analysis of performance data commensurate with the approach described under 2.b. We call this the *default rate matching approach*.

Regardless of the type of mapping approach, for each third-party rating category the best possible rating factor equivalent will be the one corresponding to the third-party 's expected default rates (i.e. based on its master scale if they have a master scale). This ensures that the resulting rating factors are no better than the third party's expected ones.

We may adjust the results of this quantitative analysis based on the qualitative analysis we describe above. These adjustments may affect the entire portfolio or only a fraction of it (e.g. an 'x'-notch adjustment is applied to the mapping only for assets originated in a particular country).

Rating Matching Approach

To establish a mapping between the third party's ratings (TPR) and our rating factors, we use a sample of borrowers with both a TPR and a Moody's rating and we establish a mapping function between the two by performing a regression of the TPR on Moody's rating, i.e. the dependent variable, adjusted to take into account the number of observations available for each TPR (for more details, see Box 1).

[33] We may also rely on Moody's Analytics RiskCalcTM (RiskCalc) to generate one-year expected default frequencies (EDFs) that may be compared to the provider's internal ratings and can be directly translated by using our idealized default probability table. For more information, see www.moodys.com.

Box 1. The Rating Matching Approach

We start with a frequency distributions table of Moody's ratings for the obligors in the sample that have been assigned the TPR (see Exhibit 8).

EXHIBIT 8

Sample Frequency Distributions of Third-Party Ratings (TPRs) and Moody's Ratings

	Moody's																				
TPR	Aaa	Aa1	Aa2	Aa3	A1	A2	A3	Baa1	Baa2	Baa3	Ba1	Ba2	Ba3	B1	B2	B3	Caa1	Caa2	Caa3	Ca	Grand Total
1	16.7%	22.2%	16.7%	16.7%	5.6%	11.1%	5.6%	5.6%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	100.0%
2	0.0%	6.5%	9.7%	9.7%	16.1%	16.1%	29.0%	12.9%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	100.0%
3	0.0%	0.0%	4.0%	8.0%	18.0%	28.0%	20.0%	18.0%	4.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	100.0%
4	3.0%	1.0%	3.0%	4.0%	12.1%	24.2%	16.2%	24.2%	7.1%	5.1%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	100.0%
5	0.0%	1.5%	0.0%	1.5%	4.6%	13.8%	20.0%	20.0%	23.1%	13.8%	1.5%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	100.0%
6	0.0%	2.2%	0.0%	0.0%	2.2%	6.5%	8.7%	26.1%	39.1%	13.0%	2.2%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	100.0%
7	0.0%	0.0%	0.0%	0.0%	0.0%	7.1%	7.1%	32.1%	39.3%	14.3%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	100.0%
8	2.9%	0.0%	0.0%	0.0%	2.9%	5.7%	17.1%	22.9%	17.1%	14.3%	8.6%	8.6%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	100.0%
9	0.0%	0.0%	0.0%	0.0%	4.2%	12.5%	0.0%	4.2%	37.5%	25.0%	4.2%	4.2%	8.3%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	100.0%
10	0.0%	0.0%	0.0%	0.0%	0.0%	3.4%	3.4%	13.8%	13.8%	37.9%	10.3%	6.9%	6.9%	3.4%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	100.0%
11	0.0%	0.0%	0.0%	0.0%	0.0%	7.1%	0.0%	7.1%	14.3%	14.3%	28.6%	7.1%	14.3%	7.1%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	100.0%
12	0.0%	0.0%	0.0%	0.0%	0.0%	5.4%	2.7%	5.4%	13.5%	18.9%	10.8%	10.8%	13.5%	10.8%	2.7%	2.7%	2.7%	0.0%	0.0%	0.0%	100.0%
13	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	9.1%	18.2%	0.0%	9.1%	0.0%	9.1%	27.3%	9.1%	18.2%	0.0%	0.0%	0.0%	0.0%	100.0%
14	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	5.9%	0.0%	11.8%	23.5%	5.9%	23.5%	11.8%	11.8%	0.0%	5.9%	0.0%	0.0%	0.0%	100.0%
15	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	16.7%	0.0%	16.7%	16.7%	0.0%	16.7%	16.7%	16.7%	0.0%	0.0%	0.0%	100.0%
16	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	5.0%	5.0%	5.0%	10.0%	5.0%	15.0%	0.0%	30.0%	20.0%	5.0%	0.0%	0.0%	100.0%
17	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	25.0%	0.0%	25.0%	12.5%	0.0%	12.5%	0.0%	12.5%	0.0%	12.5%	0.0%	100.0%
18	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	33.3%	0.0%	0.0%	33.3%	0.0%	0.0%	33.3%	0.0%	0.0%	100.0%
19	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	50.0%	50.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	100.0%
20	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	20.0%	20.0%	0.0%	20.0%	20.0%	20.0%	0.0%	0.0%	0.0%	100.0%

Source: Moody's Investors Service

Our objective is to derive a mapping function taking into account that for some TPRs, many observations (in terms of monitored Moody's ratings) are available while for others there are only few.

We consider three different statistical models: linear, exponential and second order polynomial, to explain the relationship between the monitored Moody's rating (dependent variable) and the TPR (independent variable) by fitting a curve between the percentile levels (the z%-tiles) of each TPR-specific frequency distribution of monitored Moody's ratings and the TPR. To find the optimal parameters for each model, we minimize the sum of weighted least-squares. For each TPR category, we take into account the number of observations available.

We then implement a constraint that the rating factor that the statistical model generates for the TPR representing the lowest credit risk must be equal to or worse than the respective z%-tile Moody's rating.

When choosing a certain percentile (the z%-tile), we typically conduct a sensitivity analysis by deriving alternative mapping functions using a slightly higher and/or lower percentile. We may complement our analysis by carrying out a scenario analysis for a larger number of different percentile levels where in a first step, we determine the level of credit enhancement necessary for a theoretical senior-most liability tranche with a Aaa target rating and using a portfolio mapped using the given z%-tile. Next, we calculate the rating impact (through Moody's Metric, MM) of adjusting the percentile to a higher level, using the same credit enhancement level. By repeating this exercise up to the 100th percentile and using the same incremental step size when adjusting the percentile, we can calculate the expected MM by weighting the respective percentiles by their probabilities of occurrence. The expected MM must lie within a predetermined tolerance level, which we generally take to be 2 rating subcategories. If the tolerance is exceeded, then either the starting point of the mapping must be more conservative (i.e. a higher percentile), or a larger sample must be gathered to reduce statistical uncertainty.

Default Rate Matching Approach

To establish a mapping between the third party's ratings (TPRs) and our rating factors using the default rate matching approach, we compare our Idealized Default Rates at the same time horizon and the third party's long-run average probabilities of default for each third-party rating category. If the third party's system does not include this information, we compare the performance of the provider's rating system, expressed for example by historical default rates, with the historical performance of Moody's monitoring ratings over a similar time horizon.

The rating factors we derive from this approach need to be supported by the validation results, both in terms of discriminatory power and if applicable, calibration level over a full economic cycle.

Data Quality

While reviewing the third-party rating system in our operational review as we describe above, we also assess the sample and quality of the data provided to establish the mapping. We typically review a number of key factors:

» **Rating system**: We review the rating system concept, such as the default definition (and how it differs from our default definition[34] and the securitization's default definition), the time horizon (i.e. point-in-time vs. through-the-cycle), the main components (e.g. financial, behavioral and qualitative) and the sources of the inputs.

» **Back testing and historical data**: We look for data supporting the third party's rating scale, including default rates and rating transitions, ideally covering at least the previous five years or a full economic cycle, including a recession.[35]

Typically, to create a mapping relationship between a sample of the third party's ratings and our rating factors, the sample comprises the entire universe of assets of the type that will be securitized (i.e. the sample should be representative of the securitized portfolio). The data sample may also be tailored to match the characteristics of the portfolio that will be securitized, with assets' attributes such as industry, country, obligor size and credit quality in similar proportions.

Monitoring

When monitoring a transaction where the credit quality of the portfolio is determined using a mapping, we monitor the mapping by looking for the following information:

» Reported overall delinquency and default rates in the portfolio are in line with what we would expect from the average mapped quality of the portfolio, and whether defaulted assets exhibit unusual behavior.

» Third party rating provider to confirm that there has been no significant change in their rating process or approach since the mapping was established. In case we obtain limited or insufficient confirmation, we may apply an additional default probability stress to the mapped rating factors.

We periodically refresh our mapping analysis given that the relationships between the third party's rating and our rating factors may drift over time. Our refreshing of existing mappings is generally similar to the

[34] Moody's definition of default is (1) a failure to pay interest of principal when due, (2) the filing for bankruptcy or a similar insolvency/receivership event, or (3) a restructuring or distressed exchange that has the effect of diminishing the present value of the creditor's obligation or postponing default. For more information on Moody's definition of default, see *Rating Symbols and Definitions*. A link can be found in the "Moody's Related Publications" section.

[35] We may also request to evaluate a smaller "control" sample of unrated names which have been analyzed through Moody's CreditEdge and/or RiskCalc models or which have been assigned Moody's credit estimates as a further test.

approach we use to assign initial mappings, incorporating both an updated operational review and quantitative analysis.

Other events such as significant, unexplained credit deterioration in the portfolio as well as material changes in the third-party rating process or approach may prompt a refreshing of our mapping. All mappings which are older than two years are subject to an additional default probability stress when used in our monitoring analysis. When the remaining number of mapped assets has reduced over the transaction life, we may subject the mapped assets to a default probability stress given that the mapping becomes less statistically robust the smaller the number of assets in the transaction portfolio.

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 which is available here.

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