

Global Rating Criteria for Corporate CDOs

Contents

Summary.....	1
Scope of Criteria	2
Asset Credit Analysis	3
Recovery Analysis.....	3
Concentration Risks	3
Model Portfolio	7
Cash Flow and Structure Analysis....	7
Asset Manager Analysis.....	8
Sensitivity Analysis.....	8
Surveillance	8
Appendix	9

Summary

(Editor's Note: We originally published this criteria article on 16 April 2020. We republished it following our periodic review completed on 16 April 2021.)

This criteria article describes PENGYUAN's approach in evaluating the creditworthiness of corporate Collateralized Debt Obligations (CDOs), including transactions of corporate loan portfolios, Collateralized Loan Obligations (CLOs), and transactions of corporate bond portfolios, Collateralized Bond Obligations (CBOs). It provides our analytical framework for rating cash flow CDOs backed by portfolios of corporate debt and synthetic CDOs referring portfolios of corporate obligations (the transactions are hereafter referred to as "Corporate CDOs"). These criteria may also be applied to assess other transactions that share similarities with Corporate CDOs, such as transactions backed by portfolios of sovereign securities, municipal debt and project finance loans. As asset-specific rating criteria, the criteria should be read in conjunction with the "General Structured Finance Rating Criteria", which describes factors we consider in rating structured finance transactions that may not be included in this criteria article.

As with all rating criteria for structured finance transactions, PENGYUAN utilizes a multifaceted analytical framework when assigning and monitoring credit ratings of Corporate CDOs. The process of analyzing Corporate CDOs takes into account both quantitative and qualitative factors.

To assess the securitized portfolio's credit risk, PENGYUAN analyzes the assets in the portfolio and establishes assumptions on the default rate and recovery rate for each asset, as well as a correlation framework for the portfolio. Using a Monte Carlo simulation model, PENGYUAN estimates the rating-based portfolio default rate, or Scenario Default Rate (SDR), which reflects the expected default level in various stress scenarios commensurate with PENGYUAN's ratings definitions. The estimated portfolio default rate is a function of the asset's balance, maturity, credit quality, as well as the portfolio's diversity in terms of obligor, industry and geographic concentration.

PENGYUAN evaluates the transaction's structure and cash flows through a proprietary cashflow model, incorporating assumptions on factors like principal amortization, default timing, recovery rates, recovery timing, interest rates and foreign exchange rates. The main output of the cash flow model is the Break-Even Default Rate (BDR), which represents the maximum portfolio default rate that a tranche can sustain without experiencing a loss. The BDR is compared to the SDR under the corresponding rating stress scenario. To assign a particular rating, the SDR should be at or lower than the BDR at the proposed rating level.

The asset manager plays a critical role in the managed CDOs given that, for such transactions, the asset manager actively manages the collateral pools, therefore the credit quality of the collateral pools may change over time. As part of its operational risk analysis, PENGYUAN conducts an analysis of the asset manager's quality, experience, investment process, and track record to assess the asset manager's ability to maintain the portfolio's quality based on the transaction's documents. PENGYUAN may make quantitative adjustments to its default and recovery assumptions based on the CDO manager analysis.

PENGYUAN reviews transaction documents and legal opinions to assess the legal risks of the transaction and evaluate its consistency with the criteria described in

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“General Structured Finance Rating Criteria”. PENGYUAN also applies “General Structured Finance Rating Criteria” in assessing counterparty risks and operational risks in Corporate CDOs. Based on the assessments, PENGYUAN may adjust the estimated loss expectations, apply a rating cap, or even decline to rate a transaction.

Exhibit 1: Rating Process for Corporate CDOs

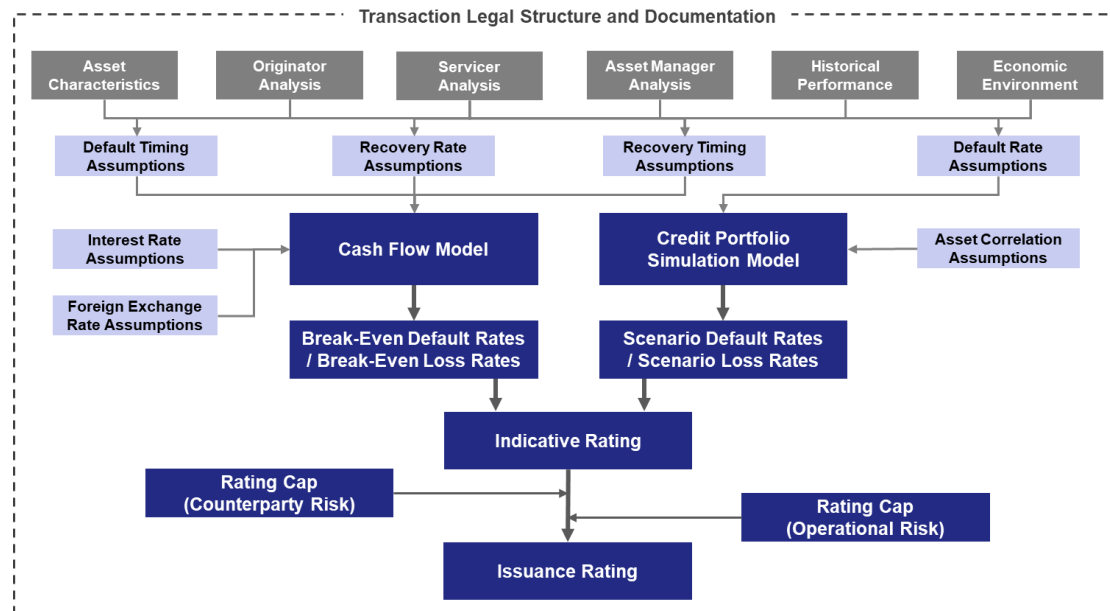


Exhibit 1 shows the rating process in assigning and monitoring credit ratings of Corporate CDOs:

- PENGYUAN reviews the transaction’s legal structure and documentation to determine whether a securitization structure effectively achieves asset isolation and insolvency remoteness, such that the transaction is not linked to any counterparty.
- PENGYUAN reviews the securitized asset and establishes assumptions for the default rate and recovery rate for each asset.
- For managed CDOs, PENGYUAN reviews the asset manager to assess the asset manager’s impact on the performance of a CDO. The review results are incorporated into the rating assumptions.
- PENGYUAN generates a set of SDRs through a Monte Carlo simulation model based on factors such as the assessment of the asset manager, the characteristics of the initial portfolio and transaction structure, as well as the default rate of the securitized asset.
- PENGYUAN conducts cash flow analysis via a cash flow model, which incorporates stress assumptions on default timing, recovery timing, recovery rate, interest rate and foreign exchange rate. The cash flow analysis determines the BDRs for each tranche within the CDO.
- PENGYUAN determines the indicative rating by comparing the BDR with the SDR under various stress scenarios.
- PENGYUAN performs counterparty risk analysis and operational risk analysis on the transaction. This may result in a rating cap on the issuance rating.

Scope of Criteria

PENGYUAN uses the criteria to rate the cash flow CDOs backed by portfolios of corporate debt and synthetic CDOs referring portfolios of corporate obligations. The criteria are applied to the new issue and surveillance of Corporate CDOs backed by or synthetics on

- broadly syndicated loans,
- middle market loans,
- loans to small and midsize enterprises (SMEs), and
- corporate bonds.

PENGYUAN may also apply the criteria in rating structures backed by different tranches issued by a CDO transaction (combination notes) and other transactions that share similarities with Corporate CDOs, such as transactions backed by portfolios of sovereign securities, municipal debt and project finance loans.

Asset Credit Analysis

To assess the securitized portfolio's credit quality, the PENGYUAN uses a Monte Carlo simulation approach to estimating a set of Scenario Default Rates, which reflect the portfolio's expected default rates under various rating stress scenarios. The estimated rating-based SDRs will be compared with the Break-Even Default Rates projected in the cash flow models to determine a tranche's indicative rating. For CDOs with static portfolios, PENGYUAN conducts the analysis based on the characteristics of the actual securitized portfolio. For CDOs which allow for reinvestment, the analysis is based on assumptions derived from the transaction's documents and the existing portfolio.

In particular, we use PENGYUAN's Credit Portfolio Simulation Model (CPSM) to project the asset's joint default behavior within the portfolio. The key assumptions for the CPSM are the asset default probabilities, pairwise asset correlation and rating quantiles. The CPSM employs a framework of multi-factor correlation model, in which the portfolio dependence structure is fully defined by pairwise asset correlation assumptions. When determining asset default, the CPSM compares the simulated asset value against a specific default threshold derived from the asset's expected default probability. With these inputs and assumptions, the CPSM runs a Monte Carlo simulation of defaults and generates a probability distribution for default rates. The rating-based SDRs are determined using assumptions on the CDO target default rate — i.e. rating quantile.

Individual Asset Default Probability

As a key input for the CPSM, an asset's default probability is generally determined by the asset's rating or credit estimate and asset maturity. The expected default probabilities for different ratings and maturities are derived based on the one-year rating transition matrix (see Exhibit 2), which reflects the historical rating transition probabilities observed in the ratings of S&P Global and Moody's. Assuming the credit rating process follows the Markov chain process, we raise the one-year rating transition matrix to a power of the maturity year to generate the cumulative transition probabilities (including the cumulative default probabilities for each rating level) for different maturities.

The borrowers' ratings in the one-year transition matrix are primarily based on PENGYUAN's issuer ratings or credit estimates. In the event that PENGYUAN does not provide an issuer rating or credit estimate, PENGYUAN may refer to public ratings by other Credit Rating Agencies, i.e. S&P Global and Moody's. In this case, we will use the lower of the public ratings by the two rating agencies.

For borrowers which do not have any above-mentioned public ratings or credit estimates, we assess their credit quality by a shadow rating approach. The shadow ratings are assigned solely for the purpose of estimating the default probabilities of the assets in CDO transactions. If the originating bank maintains an internal rating scoring system to assess the borrower's default risk, we may assign the shadow ratings based on the internal scores. Otherwise, the shadow ratings will be assigned based on the borrowers' financial statements and business profiles according to PENGYUAN rating principles. For transactions that do not offer sufficient information for assigning shadow ratings, PENGYUAN may apply a rating cap or decline to rate the transactions.

For guaranteed assets, we assess their default risk taking into account the creditworthiness of both the primary borrower and guarantor. We evaluate the support providers, i.e. guarantors, for their capacity to support the primary borrower and the enforceability of the guarantee. The asset's default probability depends on the performance of the primary borrower and guarantor, their asset correlation, and enforceability of the guarantee.

Correlation Framework

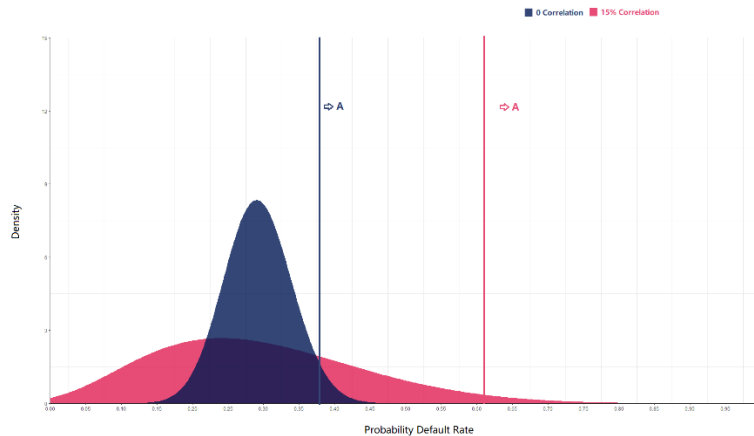
Correlation assumptions are crucial parameters used in simulating joint defaults in the CPSM. For given asset default probabilities, the correlation assumptions are the parameters that determine the shape of the simulated distribution of default rates. Exhibit 3 illustrates the impact of different correlation assumptions on the distribution of default rates. As we can see from the exhibit, the simulated distribution with a pairwise correlation of 15% is much flatter and more spread out than the one with zero correlation assumption. That means the securitized portfolio is more likely to experience a high level of defaults if the assets in the portfolio have higher correlation.

The CPSM models the correlated defaults using a framework of multi-factor model, which assumes the values of the assets are driven by a set of common risk factors and an idiosyncratic risk factor. Under this framework, defaults are correlated because the assets are exposed to common risk factors. In the CPSM, the correlation is defined through common factors related to geography (e.g. region, country, and province) and sector and industry.

Exhibit 2: One-Year Credit Rating Transition Probabilities (%)

From/to	AAA	AA+	AA	AA-	A+	A	A-	BBB+	BBB	BBB-	BB+	BB	BB-	B+	B	B-	CCC+	CCC	CCC-	D
AAA	85.265	7.080	5.167	0.942	0.580	0.363	0.214	0.146	0.084	0.058	0.037	0.024	0.014	0.009	0.005	0.004	0.002	0.001	0.001	0.003
AA+	2.048	79.903	9.142	4.149	1.933	1.179	0.637	0.390	0.237	0.136	0.089	0.049	0.033	0.026	0.017	0.009	0.009	0.006	0.001	0.007
AA	0.670	3.178	77.050	8.763	4.347	2.565	1.399	0.800	0.498	0.291	0.170	0.101	0.058	0.040	0.022	0.017	0.007	0.008	0.002	0.014
AA-	0.166	0.360	4.666	76.834	9.649	4.625	1.449	0.837	0.539	0.327	0.192	0.122	0.074	0.046	0.027	0.017	0.011	0.008	0.002	0.049
A+	0.088	0.112	2.093	6.623	74.184	8.775	3.760	1.657	1.026	0.612	0.385	0.239	0.139	0.091	0.051	0.031	0.021	0.013	0.005	0.095
A	0.056	0.062	1.119	2.006	5.581	73.802	9.332	4.432	1.189	0.915	0.526	0.321	0.217	0.126	0.064	0.035	0.023	0.017	0.008	0.168
A-	0.036	0.044	0.584	1.153	2.141	6.303	73.172	8.817	4.420	1.277	0.730	0.425	0.261	0.164	0.092	0.055	0.037	0.021	0.015	0.256
BBB+	0.020	0.026	0.311	0.606	1.192	2.122	7.483	72.714	8.863	2.760	1.475	0.856	0.505	0.325	0.168	0.098	0.064	0.038	0.024	0.349
BBB	0.017	0.021	0.158	0.403	0.822	1.396	2.834	8.016	71.653	7.178	3.050	1.691	1.060	0.532	0.367	0.184	0.123	0.055	0.035	0.404
BBB-	0.011	0.009	0.084	0.174	0.356	0.743	1.296	3.397	7.521	68.304	7.313	4.462	2.766	1.472	0.822	0.404	0.214	0.109	0.070	0.472
BB+	0.007	0.005	0.046	0.092	0.219	0.418	0.733	0.943	2.750	8.615	66.158	9.081	5.794	1.977	1.028	0.602	0.294	0.191	0.111	0.936
BB	0.002	0.003	0.026	0.053	0.120	0.243	0.432	0.580	1.401	3.885	8.125	64.150	8.943	4.163	3.179	1.578	0.764	0.330	0.179	1.844
BB-	0.001	0.005	0.013	0.028	0.069	0.158	0.268	0.335	0.888	1.471	4.128	6.491	63.257	10.752	5.272	2.538	1.126	0.552	0.265	2.381
B+	0.003	0.003	0.010	0.016	0.041	0.072	0.149	0.221	0.545	0.943	2.480	3.410	6.693	62.921	11.344	4.738	2.002	0.935	0.459	3.016
B	0.000	0.004	0.003	0.010	0.020	0.042	0.098	0.155	0.344	0.647	1.582	2.018	4.652	9.075	61.357	7.257	3.403	1.618	0.781	6.933
B-	0.003	0.001	0.007	0.004	0.016	0.028	0.058	0.086	0.208	0.421	1.049	1.309	2.877	5.101	9.113	58.614	5.974	3.915	1.402	9.815
CCC+	0.000	0.003	0.001	0.002	0.005	0.015	0.026	0.055	0.125	0.275	0.690	0.878	1.833	3.060	4.970	9.098	48.542	10.939	5.885	13.598
CCC	0.000	0.000	0.002	0.001	0.008	0.010	0.015	0.032	0.092	0.204	0.458	0.587	1.204	2.009	3.485	6.188	11.053	44.289	11.700	18.663
CCC-	0.000	0.000	0.000	0.001	0.002	0.007	0.012	0.020	0.050	0.122	0.337	0.409	0.783	1.289	2.534	4.288	9.057	18.216	37.062	25.813

Exhibit 3: Effect of Portfolio Correlation

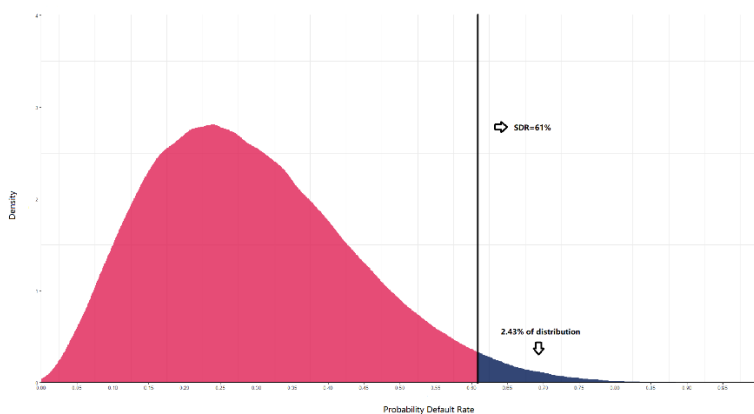


PENGYUAN defines the correlation assumptions in line with industry benchmarks (see Appendix 1 for the correlation assumptions employed by the CPSM). For instance, the correlation assumptions are set at 20% for two firms in the same industry by S&P Global and set between 12% and 24% in the BASEL III framework for large corporates. In addition, the correlation assumptions are calibrated with another parameter - rating quantiles - to be consistent with our rating definitions and understanding of the stress levels represented by historical data. In our view, the most stressful scenarios in North America and Western Europe since 1981 correspond to a 'BBB' level of stress according to the rating definitions. Therefore, the SDRs simulated by the CPSM under the 'BBB' stress scenario should be in the same range as the observed peak default rates since 1981. Furthermore, CDO notes rated in the 'AAA(sf)' category should survive under the stress scenarios where the default rates exceed historical peak default rates.

Rating Quantiles

After simulating the distribution of default rates for a given portfolio, the CPSM uses rating quantiles associated with each rating level to derive the SDRs. The rating quantile assumptions reflect the assumed risk tolerance levels for various ratings and maturities. Exhibit 4 illustrates the relationship between the rating quantiles and SDRs. It shows that the probability that the asset default rate in the portfolio exceeds 61% is less than 2.43% (represented by the blue area in Exhibit 4).

Exhibit 4: Simulated Distribution of Default Rates



The rating quantile is a function of rating and maturity. Since the assets in a securitized portfolio generally have different maturity dates, the target default rates are determined by the weighted average life (WAL) of the portfolio. If the WAL is not a whole number, the model applies interpolation.

Like other assumptions, the rating quantiles are model parameters subject to calibration. PENGYUAN uses the cumulative asset default probabilities, which we derived previously, as a starting point to determine the rating quantile assumptions. We

further adjust the rating quantiles so that the SDRs generated by the CPSM are consistent with historical observed default rates and targeted 'AAA' default rates under the stress scenarios commensurate with our rating definitions.

Testing the Model's Calibration

We test the model outputs against the historical default rates and targeted portfolio default rates. In order to validate the CPSM, we use homogeneous portfolios of corporate credits, which all have the same credit ratings. The portfolios are composed of 125 equally weighted corporates across 24 industries. We analyze the portfolios using the CPSM with the assumptions we specified above. We then compare the SDRs generated by the CPSM with the targeted portfolio default rates under various rating stress scenarios and ensure the model's calibration is consistent with our rating definitions.

Recovery Analysis

We assign a recovery rate to each asset based on the collateral, type of asset, legal jurisdiction, seniority of the asset in the corporate capital structure and the stress level corresponding to the proposed tranche rating. The recovery rate assumptions depend on the information available to us. If we have detailed information on the pledged collateral for each asset, we form our recovery rate assumptions taking into account both the recovery from the collateral and from the asset itself. Otherwise, we derive the asset recovery rate based on the asset type, legal jurisdiction and seniority of the asset.

Recovery from Collateral

We estimate the collateral recovery rates according to the type of collateral. The collateral is divided into two categories: financial collateral (e.g. cash, bank deposits, securities and bonds) and non-financial collateral (e.g. receivables, real estate, and equipment). For financial collateral, the recovery is calculated as:

$$\text{Financial Collateral Recovery} = \text{Collateral Value} \times (1 - \text{Discount Rate})$$

For non-financial collateral, they will be treated as eligible collateral only if the collateral meets the minimum eligibility requirements (minimum collateralization level). The recovery for non-financial collateral is calculated as:

$$\text{Non-financial Collateral Recovery} = \frac{\text{Collateral Value}}{\text{Over-Collateralization Level}} \times \text{Collateral Recovery Rate}$$

The assumptions on discount rate, minimum collateralization level, over-collateralization level, and collateral recovery rate can be found in Appendix 3.

Recovery Rates Based on Asset Characteristics

If detailed information on the pledged collateral is not available to us, we assign the recovery rates based on the asset characteristics, i.e. asset type, country of asset and seniority of asset. The recovery assumptions applicable in this case can be found in Exhibits 8 to 12 in Appendix 3. For assets whose characteristics do not match those described in Appendix 3, we may conduct a recovery analysis and assign specific recovery rates based on the assets' particular risk factors.

Concentration Risks

The CPSM is built to assess Corporate CDO transactions that are supported by relatively diversified portfolios and have fairly even exposure to all obligors. When analyzing portfolios dominated by large obligors or with a small number of obligors, we apply concentration tests to address the potential risk that the credit quality of the portfolios may be overly affected by a few obligors. Specifically, we stress the model assumptions to mitigate the model risk that may be present when assessing concentrated portfolios under the CPSM.

The concentration tests are typically applied in the following steps: 1) we evaluate the concentration level of the portfolio based on the Inverse Herfindahl–Hirschman index (Inverse HHI), which can be interpreted as the effective number of obligors in the portfolio. The concentration test will be triggered if the Inverse HHI of the portfolio is lower than 20. 2) PENGYUAN applies a haircut of 30% to the standard recovery rate of the large obligors. In addition, a 30% correlation add-on is applied to the large obligors in order to increase the correlations among these large risk contributors.

Model Portfolio

CDO transactions can be static or managed. For static CDOs, PENGYUAN conducts the credit analysis based on the identified assets in the securitized portfolio. For managed CDOs, PENGYUAN reviews the supplied initial portfolio and may construct a model portfolio to account for additional risks due to reinvestment and asset trading. Managed CDOs typically include eligibility criteria and covenants in their transaction documents to govern allowed reinvestment. PENGYUAN performs the analysis on the identified initial portfolio, transaction documents and the asset manager's ability to determine the extent to which the portfolio's credit quality may change during the revolving period. For transactions with managed portfolios, PENGYUAN assigns the ratings according to the model portfolio based on the analysis of the covenants in the transaction documents and the asset manager's ability and commitment to maintain the portfolio's credit quality during the reinvestment period.

Cash Flow and Structure Analysis

PENGYUAN conducts a cash flow analysis to assess the transaction structure by projecting the transaction's cash flow under various rating stress scenarios. We use our cash flow model to simulate the impact of the cash flow stresses on the rated securities, taking into account the transaction's structural features. The key inputs and assumptions in the cash flow analysis are the portfolio amortization schedule, default timing, recovery rate and timing, expected note size and coupons, transaction fees and expenses, liquidity reserves, interest rate stresses and foreign exchange risk stresses etc.

The cash flow analysis determines the Break-Even Default Rate (BDR), which represents the maximum portfolio default rate that a tranche can sustain without experiencing a loss. The BDR is compared to the SDR generated by the CPSM under the stress scenario commensurate with the proposed tranche rating. A rating can be assigned only if the SDR is at or lower than the BDR at the rating level.

The following provides the assumptions we apply in the cash flow modelling of CDO transactions. They should be applied in conjunction with the methodology described in "General Structured Finance Rating Criteria".

Portfolio Amortization Schedule

For static CDOs or transactions past their reinvestment period, we typically apply the actual portfolio amortization schedule. For managed CDOs still in their reinvestment period, we use a standardized amortization schedule in our cash flow analysis, given that the portfolio maturity profile keeps changing over the reinvestment period. In cases where we believe the portfolio does not follow the standardized amortization schedule, we may construct bespoke amortization schedules to reflect the portfolio's characteristics.

Default Timing

We use different default timing and patterns to assess the transaction's ability to withstand various default distributions. In particular, the default timing scenarios we apply in the cash flow analysis include the front-loaded, mid-loaded, back-loaded, and flat default scenario (see Appendix 4). The default timing is adjusted according to the transaction's characteristics such as the portfolio's weighted average life (WAL). The default amounts are typically spread out in each payment period.

Recovery Lag

We assume the recovery proceeds are received following a time lag after default. Typically, the recovery lag is assumed to be 12 months after default. However, the timing of recovery varies with the transaction's characteristics (e.g. the legal jurisdiction and asset manager's experience). We may assume a different recovery lag time from the 12-month base case assumption, if the characteristics of the securitized portfolios are significantly different than the portfolios in typical transactions.

Interest Rate Risk

Interest rate risk in CDO transactions may be present due to mismatch between interest earned from the assets and liabilities. For instance, the asset interest rate is fixed, while the liability interest payment may be on a floating rate basis. In addition to the fixed versus floating interest risk, the floating rate asset may be based on a different benchmark rate from that of the

issued notes. For transactions where the interest rate risk is not fully hedged, we apply a series of interest stress curves in our cash flow analysis to test the transactions' sensitivity to interest rate movements.

Foreign Exchange Risk

Foreign exchange risk arises when CDO transactions' assets and liabilities are held in different currencies. Most CDO transactions mitigate this risk by entering into currency swaps. For transactions with significant residual foreign exchange risk, we use foreign exchange stress tests to assess the impact of foreign exchange risk. In particular, we generate a series of foreign exchange rate depreciation curves under each rating stress level and apply the depreciation stresses when the foreign exchange risk is not fully hedged.

Asset Manager Analysis

For managed CDO transactions, the asset manager's capability is essential for the transactions' performance. As part of the rating process, PENGYUAN conducts an analysis of asset manager's quality, experience, investment process and track record to assess the asset manager's ability to maintain the portfolio's quality based on the transaction's documents. The asset manager analysis typically includes a management meeting to discuss the asset manager's management experience, investment strategy, business model and financial condition. The asset manager analysis is qualitative in nature. However, PENGYUAN may make quantitative adjustments to default and recovery assumptions based on the CDO manager analysis.

Sensitivity Analysis

PENGYUAN conducts sensitivity analysis to mitigate potential model and methodology risks. In particular, we test the rating sensitivity with respect to assumptions such as default probability, recovery rate and asset correlation. We systematically modify the assumptions and investigate whether such changes would result in a significant change in model output and ratings. The rating committee will consider the sensitivity analysis results when assigning the ratings based on the model output.

Surveillance

Based on the performance reports generated by asset manager or trustee, PENGYUAN conducts the rating surveillance on an annual basis or more frequently in the event of material changes.

Appendix 1: Correlation Assumptions

Country		Region		Country		Region	
Country Name	Correlation add-ons	Region Name	Correlation add-ons	Country Name	Correlation add-ons	Region Name	Correlation add-ons
Liberia	0.1	Africa	0.02	Costa Rica	0.1	Latin America	0.02
Morocco	0.1	Africa	0.02	Dominican Republic	0.1	Latin America	0.02
Other Africa	0.1	Africa	0.02	Ecuador	0.1	Latin America	0.02
South Africa	0.1	Africa	0.02	El Salvador	0.1	Latin America	0.02
Asia Others	0.1	Asia Developing Markets	0.02	Guatemala	0.1	Latin America	0.02
China	0.05	Asia Developing Markets	0.02	Jamaica	0.1	Latin America	0.02
Hong Kong	0.05	Asia Developed Markets	0.02	Mexico	0.1	Latin America	0.02
India	0.1	Asia Developing Markets	0.02	Other America	0.1	Latin America	0.02
Indonesia	0.1	Asia Developing Markets	0.02	Panama	0.1	Latin America	0.02
Japan	0.05	Asia Developed Markets	0.02	Peru	0.1	Latin America	0.02
Malaysia	0.1	Asia Developing Markets	0.02	Puerto Rico	0.1	Latin America	0.02
Marshall Islands	0.1	Asia Developing Markets	0.02	Uruguay	0.1	Latin America	0.02
Mauritius	0.1	Asia Developing Markets	0.02	Venezuela	0.1	Latin America	0.02
Pakistan	0.1	Asia Developing Markets	0.02	Cyprus	0.05	Mediterranean Europe	0.02
Philippines	0.1	Asia Developing Markets	0.02	Gibraltar	0.05	Mediterranean Europe	0.02
Singapore	0.05	Asia Developed Markets	0.02	Greece	0.05	Mediterranean Europe	0.02
South Korea	0.05	Asia Developed Markets	0.02	Italy	0.05	Mediterranean Europe	0.02
Taiwan	0.05	Asia Developed Markets	0.02	Malta	0.05	Mediterranean Europe	0.02
Thailand	0.1	Asia Developing Markets	0.02	Portugal	0.05	Mediterranean Europe	0.02
Vietnam	0.1	Asia Developing Markets	0.02	Spain	0.05	Mediterranean Europe	0.02
Australia	0.05	Australia and New Zealand	0.02	Egypt	0.1	Middle East	0.02
New Zealand	0.05	Australia and New Zealand	0.02	Iran	0.1	Middle East	0.02
Albania	0.1	Europe Developing Markets	0.02	Israel	0.1	Middle East	0.02
Bosnia and Herzegovina	0.1	Europe Developing Markets	0.02	Other Middle East	0.1	Middle East	0.02
Bulgaria	0.05	Europe Developing Markets	0.02	Qatar	0.1	Middle East	0.02
Croatia	0.05	Europe Developing Markets	0.02	Saudi Arabia	0.1	Middle East	0.02
Czech Republic	0.05	Europe Developing Markets	0.02	Tunisia	0.1	Middle East	0.02
Eastern Europe Others	0.1	Europe Developing Markets	0.02	Turkey	0.1	Middle East	0.02
Estonia	0.05	Europe Developing Markets	0.02	Denmark	0.05	Nordics	0.02
Hungary	0.05	Europe Developing Markets	0.02	Finland	0.05	Nordics	0.02
Kazakhstan	0.1	Europe Developing Markets	0.02	Iceland	0.05	Nordics	0.02
Latvia	0.05	Europe Developing Markets	0.02	Norway	0.05	Nordics	0.02
Lithuania	0.05	Europe Developing Markets	0.02	Sweden	0.05	Nordics	0.02
Macedonia	0.1	Europe Developing Markets	0.02	Ireland	0.05	UK and Ireland	0.02
Moldova	0.1	Europe Developing Markets	0.02	Jersey	0.05	UK and Ireland	0.02
Poland	0.05	Europe Developing Markets	0.02	United Kingdom	0.05	UK and Ireland	0.02
Romania	0.05	Europe Developing Markets	0.02	Bermuda	0.1	US and Canada	0.02
Russia	0.1	Europe Developing Markets	0.02	Canada	0.05	US and Canada	0.02
Serbia and Montenegro	0.1	Europe Developing Markets	0.02	Cayman Islands	0.1	US and Canada	0.02
Slovakia	0.05	Europe Developing Markets	0.02	United States	0.05	US and Canada	0.02
Slovenia	0.05	Europe Developing Markets	0.02	Austria	0.05	Western Europe	0.02
Ukraine	0.1	Europe Developing Markets	0.02	Belgium	0.05	Western Europe	0.02
Argentina	0.1	Latin America	0.02	France	0.05	Western Europe	0.02
Bahamas	0.1	Latin America	0.02	Germany	0.05	Western Europe	0.02
Barbados	0.1	Latin America	0.02	Liechtenstein	0.05	Western Europe	0.02
Brazil	0.1	Latin America	0.02	Luxembourg	0.05	Western Europe	0.02
Chile	0.1	Latin America	0.02	Netherlands	0.05	Western Europe	0.02
Colombia	0.1	Latin America	0.02	Switzerland	0.05	Western Europe	0.02

The CPSM uses a multi-factor framework to model correlated defaults. Under this framework, the value of the borrower i 's asset, V_i , is driven by a set of common risk factors and an idiosyncratic risk factor. Typically, the asset value, V_i , can be represented as

$$V_i = a_1 f_{global} + a_2 f_{region} + a_3 f_{country} + a_4 f_{province} + a_5 f_{govrelated} + a_6 f_{sector} + a_7 f_{industry} + b \varepsilon_i$$

$$b = \sqrt{1 - a_1^2 - a_2^2 - a_3^2 - a_4^2 - a_5^2 - a_6^2 - a_7^2}$$

where f_{global} , f_{region} , $f_{country}$, $f_{province}$, $f_{govrelated}$, f_{sector} and $f_{industry}$ are the global risk factor, region-specific risk factor, country-specific risk factor, province-specific risk factor, government related risk factor, sector-specific risk factor and industry-specific risk factor, respectively. ε_i is the idiosyncratic risk factor for the asset i . And $a_1, a_2, a_3, a_4, a_5, a_6$ and a_7 are factor loadings for the common risk factors.

Under the multi-factor framework, two assets are correlated due to their exposure to common risk factors. The correlation assumptions are set to reflect the portfolio's geographic and industrial concentration. We assume that assets from the same region or industry are exposed to the common risk factors, therefore their asset values are more correlated than the values of the assets from different region and industry. In the CPSM, if two assets are driven by the same risk factor, a correlation add-on is added to the pair-wise correlation level of the two assets. Specifically, we assume that all assets have exposure to a global risk factor and apply a base level of correlation, 2%, to all assets. In addition, correlation add-ons are applied to the assets from the same industry or located in the same region. Exhibit 5 and 6 show PENGYUAN's standard geography and industry correlation assumptions for corporate assets.

Exhibit 6: Industry Correlation Assumptions

Industry		Sector	
Industry Name	Correlation add-ons	Sector Name	Correlation add-ons
Telecommunication Services	0.095	Communication Services	0.025
Consumer Services	0.085	Consumer Discretionary	0.015
Retailing	0.08	Consumer Discretionary	0.015
Automobiles & Components	0.105	Consumer Discretionary	0.015
Consumer Durables & Apparel	0.095	Consumer Discretionary	0.015
Media	0.115	Consumer Discretionary	0.015
Food & Staples Retailing	0.08	Consumer Staples	0.02
Food, Beverage & Tobacco	0.105	Consumer Staples	0.02
Household & Personal Products	0.105	Consumer Staples	0.02
Energy	0.115	Energy	0.035
Banks	0.08	Financials	0.125
Diversified Financials	0.09	Financials	0.125
Insurance	0.085	Financials	0.125
Health Care Equipment & Services	0.1	Health Care	0.025
Pharmaceuticals, Biotechnology & Life Sciences	0.1	Health Care	0.025
Capital Goods	0.07	Industrials	0.02
Transportation	0.085	Industrials	0.02
Commercial & Professional Services	0.095	Industrials	0.02
Technology Hardware & Equipment	0.11	Information Technology	0.02
Semiconductors & Semiconductor Equipment	0.12	Information Technology	0.02
Software & Services	0.105	Information Technology	0.02
Materials	0.105	Materials	0.035
Real Estate	0.085	Real Estate	0.07
Utilities	0.075	Utilities	0.035

Appendix 2: Rating Quantiles for CPSM

Exhibit 7: Rating Quantiles for CPSM (%)

Year	AAA	AA+	AA	AA-	A+	A	A-	BBB+	BBB	BBB-	BB+	BB	BB-	B+	B	B-	CCC+	CCC	CCC-	CC	C	D
1	0.0010	0.0158	0.0258	0.1247	0.1792	0.2782	0.4366	0.6297	0.7287	1.7979	2.4761	3.5156	5.8125	9.0104	10.9211	14.4259	18.7897	25.7644	34.2464	100.0000	100.0000	100.0000
2	0.0109	0.0703	0.1099	0.3228	0.4861	0.7683	1.0455	1.3772	1.8227	3.7731	5.5155	7.0253	11.5251	16.4654	19.8760	27.2667	32.0774	43.8806	52.7048	100.0000	100.0000	100.0000
3	0.0258	0.1495	0.2386	0.5158	0.7485	1.0851	1.8375	2.1593	3.0998	6.0947	8.1490	12.5993	17.6732	22.8412	27.5290	36.4097	41.8213	55.2209	63.8688	100.0000	100.0000	100.0000
4	0.0505	0.2584	0.4119	0.7831	1.2683	1.6247	2.4959	3.7236	4.6492	9.1787	13.1883	16.2426	22.8759	29.4497	36.2166	45.1320	50.8109	63.9634	72.0582	100.0000	100.0000	100.0000
5	0.0802	0.3822	0.6594	1.1445	1.8227	2.4316	3.8226	5.1443	5.9016	11.5845	16.8812	21.1581	28.2864	36.7562	42.1717	49.0872	56.6958	68.2679	77.0768	100.0000	100.0000	100.0000
6	0.1347	0.5059	0.8673	1.5059	2.1147	3.0652	4.8225	6.1591	8.5599	14.8070	20.4602	26.3955	33.0485	42.3252	50.1663	57.2698	63.4729	74.3845	81.7272	100.0000	100.0000	100.0000
7	0.1792	0.6792	1.1742	2.1395	2.7781	3.8424	5.8224	8.4114	10.8419	17.0643	24.0590	31.5437	37.6374	47.1269	54.5967	62.5764	67.2302	78.1961	84.3449	100.0000	100.0000	100.0000
8	0.2535	0.9564	1.7039	2.8919	3.3572	4.4413	7.4808	10.1192	12.3864	20.6879	27.1677	35.5088	44.9537	51.6316	59.2697	66.2693	70.9230	80.7452	86.6321	100.0000	100.0000	100.0000
9	0.3426	1.1495	2.1147	3.6889	4.5255	5.6442	8.9114	11.3766	14.9902	22.6531	31.9743	41.2807	46.0378	56.5372	63.2942	67.7593	73.9923	81.8544	88.4305	100.0000	100.0000	100.0000
10	0.4119	1.5405	2.4464	3.9414	5.2977	6.3472	11.0152	14.0794	17.0445	26.2123	36.0731	44.9141	51.8692	60.8488	67.3583	72.0462	76.9837	84.4106	90.0564	100.0000	100.0000	100.0000
11	0.5455	1.6692	3.3374	4.6938	6.0798	7.8174	11.7825	14.9209	18.7920	30.9150	38.2858	49.0624	55.2551	63.2497	70.1255	75.6598	78.9913	86.4949	91.1662	100.0000	100.0000	100.0000
12	0.6841	2.2632	3.8275	5.4710	7.5204	8.7827	12.8715	17.4950	21.4651	31.4546	39.7560	52.2553	60.0667	66.9673	74.8876	77.3973	82.3554	87.4796	92.7725	100.0000	100.0000	100.0000
13	0.8128	2.4910	3.8869	5.7927	8.4757	9.8618	14.8813	20.0394	23.4847	33.7069	47.1071	54.0077	63.4625	71.1700	76.4073	80.9664	83.4104	89.4412	93.3824	100.0000	100.0000	100.0000
14	0.9564	3.0058	5.1047	7.3124	9.6192	10.9855	15.9159	22.5294	27.0340	38.8749	47.3744	57.9332	65.4723	72.3234	81.1991	82.7238	86.7489	90.3734	94.8605	100.0000	100.0000	100.0000
15	1.0900	3.2780	5.9709	8.8074	10.5152	12.3864	18.6335	23.9946	28.9201	41.7856	49.6267	61.2300	69.2642	74.9272	82.7188	83.2039	87.7715	90.5703	95.4026	100.0000	100.0000	100.0000
16	1.2683	3.9661	6.3323	9.7875	11.5003	14.2576	19.3068	26.3014	30.7764	44.6072	52.9285	65.1605	69.4226	77.8775	84.4415	87.3027	88.9264	92.7929	95.9846	100.0000	100.0000	100.0000
17	1.5504	4.0453	7.0847	10.5598	13.7477	15.6882	21.3265	27.4499	32.2911	47.1665	56.1956	69.0939	73.8282	80.3774	86.2532	88.3967	90.1370	93.3139	96.5774	100.0000	100.0000	100.0000
18	1.7435	5.4611	8.2233	11.3073	14.5684	16.3664	23.5194	30.1675	36.5533	48.1813	58.6856	69.1058	75.6153	80.7041	89.3917	89.4362	92.3051	93.7880	97.4758	100.0000	100.0000	100.0000
19	1.9019	5.7234	9.2183	11.5746	14.6536	17.7425	26.5242	32.0981	37.1373	49.2159	60.4677	74.6896	80.3269	85.3523	90.1540	91.5945	92.7505	94.9195	97.7974	100.0000	100.0000	100.0000
20	2.3821	6.4016	9.5450	13.0299	16.9257	20.3414	27.5786	34.3623	38.8007	51.7207	63.9328	76.4964	80.3873	86.7087	92.7974	92.7974	94.5846	95.4782	98.5309	100.0000	100.0000	100.0000
21	2.4811	6.6392	11.5350	15.2625	17.0495	22.2274	27.6132	34.4791	41.3847	54.3195	65.0516	78.2240	83.9019	88.5650	93.4805	94.3171	94.9457	96.2329	98.8660	100.0000	100.0000	100.0000
22	2.5751	7.3570	12.2428	15.6486	19.5147	22.5294	30.0685	36.7909	42.7856	56.1362	68.6157	79.4814	85.9315	90.4263	95.7180	95.7180	96.5164	96.9157	99.0000	100.0000	100.0000	100.0000
23	2.9365	8.5599	12.8963	17.1237	20.9156	24.9748	32.3802	39.3897	46.5675	59.3291	69.6948	83.1148	86.3473	91.2529	97.0793	97.0793	97.4117	97.5778	99.0000	100.0000	100.0000	100.0000
24	2.9810	8.6540	13.4606	18.9207	22.6977	25.2173	34.1722	41.6520	49.5890	61.4082	70.5463	83.9663	89.4164	93.4409	98.1436	98.1436	98.1436	98.1436	99.0000	100.0000	100.0000	100.0000
25	3.7879	9.3717	15.3773	20.3176	22.7323	27.1627	36.0236	43.0727	49.5921	62.2002	73.8827	84.5454	89.6936	95.2874	99.0000	99.0000	99.0000	99.0000	99.0000	100.0000	100.0000	100.0000
26	4.1344	10.8667	15.5793	20.4800	24.7421	29.1527	36.1374	43.6716	53.1265	64.9080	75.2440	87.4165	92.0301	95.8269	99.0000	99.0000	99.0000	99.0000	99.0000	100.0000	100.0000	100.0000
27	4.2186	10.9507	17.6485	21.2224	26.4252	31.0932	37.6077	45.6171	53.5522	66.4327	78.7091	89.4511	93.3964	96.4506	99.0000	99.0000	99.0000	99.0000	99.0000	100.0000	100.0000	100.0000
28	4.4661	10.9607	17.8514	21.9155	28.1775	32.9545	39.5333	48.4387	55.0373	67.7346	79.7140	91.5599	94.2132	97.0892	99.0000	99.0000	99.0000	99.0000	99.0000	100.0000	100.0000	100.0000
29	4.9047	12.4805	19.7325	23.6481	29.2467	33.2217	41.1173	49.2307	58.2252	70.3710	80.9615	92.9261	94.9953	97.8565	99.0000	99.0000	99.0000	99.0000	99.0000	100.0000	100.0000	100.0000
30	5.0651	13.5299	21.1680	26.8954	29.3111	33.9643	41.8896	51.8989	60.4182	70.4522	82.8772	94.3963	96.7229	98.2476	99.0000	99.0000	99.0000	99.0000	99.0000	100.0000	100.0000	100.0000

Appendix 3: Recovery Rate Assumptions

Our asset recovery rate assumptions are based on the asset type, legal jurisdiction and seniority of the asset. Under the recovery framework, assets are categorized into four asset types, i.e. corporate or SME assets, sovereign assets, municipal assets, and local government financing vehicle (LGFV) assets. Based on their legal insolvency framework, we divide the countries into 'First Class', 'Second Class', 'Third Class', 'Fourth Class', and 'China'. The expected recovery rates are decreasing from 'First Class' to 'Fourth Class' country. In addition, assets are classified into four levels according to the seniority of the assets. Exhibit 8 shows PENGYUAN's country classification for recovery rate assumptions. Exhibit 9 and 10 present PENGYUAN's standard recovery rate assumptions for corporate or SME assets, sovereign assets, municipal assets, and LGFV assets.

Exhibit 8: Country Classification for Recovery Rate Assumptions

Country	Group	Country	Group
China	China	Dominican Republic	Third Class
Australia	First Class	Eastern Europe Others	Third Class
Austria	First Class	Ecuador	Third Class
Belgium	First Class	Egypt	Third Class
Canada	First Class	El Salvador	Third Class
Denmark	First Class	Estonia	Third Class
Finland	First Class	Gibraltar	Third Class
France	First Class	Guatemala	Third Class
Germany	First Class	Hungary	Third Class
Hong Kong	First Class	Iceland	Third Class
Israel	First Class	India	Third Class
Japan	First Class	Indonesia	Third Class
Luxembourg	First Class	Iran	Third Class
Netherlands	First Class	Jamaica	Third Class
Norway	First Class	Jersey	Third Class
Singapore	First Class	Kazakhstan	Third Class
Sweden	First Class	Latvia	Third Class
Switzerland	First Class	Liberia	Third Class
United Kingdom	First Class	Liechtenstein	Third Class
United States	First Class	Lithuania	Third Class
Ireland	Second Class	Macedonia	Third Class
Poland	Second Class	Malaysia	Third Class
Portugal	Second Class	Malta	Third Class
Spain	Second Class	Marshall Islands	Third Class
Brazil	Second Class	Mauritius	Third Class
Chile	Second Class	Other Middle East	Third Class
Czech Republic	Second Class	Moldova	Third Class
Greece	Second Class	Morocco	Third Class
Italy	Second Class	Other America	Third Class
Mexico	Second Class	Other Africa	Third Class
New Zealand	Second Class	Pakistan	Third Class
South Africa	Second Class	Panama	Third Class
South Korea	Second Class	Peru	Third Class
Taiwan	Second Class	Philippines	Third Class
Turkey	Second Class	Puerto Rico	Third Class
Albania	Third Class	Qatar	Third Class
Argentina	Third Class	Romania	Third Class
Asia Others	Third Class	Russia	Third Class
Bahamas	Third Class	Saudi Arabia	Third Class
Barbados	Third Class	Serbia and Montenegro	Third Class
Bermuda	Third Class	Slovakia	Third Class
Bosnia and Herzegovina	Third Class	Slovenia	Third Class
Bulgaria	Third Class	Thailand	Third Class
Cayman Islands	Third Class	Tunisia	Third Class
Colombia	Third Class	Ukraine	Third Class
Costa Rica	Third Class	Uruguay	Third Class
Croatia	Third Class	Venezuela	Third Class
Cyprus	Third Class	Vietnam	Third Class

Exhibit 9: Standard Recovery Rate Assumptions for Corporates (%)

Very Strong		Scenario Rating																		
Country Group	Included Country Number	AAA	AA+	AA	AA-	A+	A	A-	BBB+	BBB	BBB-	BB+	BB	BB-	B+	B	B-	CCC+	CCC	CCC-
First Class	19	50	55	55	55	60	60	60	65	65	65	75	75	75	80	80	80	80	80	80
Second Class	15	40	42	42	42	46	46	46	50	50	50	60	60	60	64	64	64	64	64	64
Third Class	61	18	20	20	20	28	28	28	30	30	30	33	33	33	35	35	35	35	35	35
China	1	18	20	20	20	28	28	28	30	30	30	33	33	33	35	35	35	35	35	35
Strong		Scenario Rating																		
Country Group	Included Country Number	AAA	AA+	AA	AA-	A+	A	A-	BBB+	BBB	BBB-	BB+	BB	BB-	B+	B	B-	CCC+	CCC	CCC-
First Class	19	40	45	45	45	50	50	50	53	53	53	63	63	63	68	68	68	68	68	68
Second Class	15	32	35	35	35	40	40	40	42	42	42	50	50	50	54	54	54	54	54	54
Third Class	61	17	19	19	19	27	27	27	29	29	29	31	31	31	34	34	34	34	34	34
China	1	17	19	19	19	27	27	27	29	29	29	31	31	31	34	34	34	34	34	34
Moderate		Scenario Rating																		
Country Group	Included Country Number	AAA	AA+	AA	AA-	A+	A	A-	BBB+	BBB	BBB-	BB+	BB	BB-	B+	B	B-	CCC+	CCC	CCC-
First Class	19	18	20	20	20	23	23	23	26	26	26	30	30	30	33	33	33	33	33	33
Second Class	15	12	16	16	16	18	18	18	21	21	21	23	23	23	25	25	25	25	25	25
Third Class	61	10	12	12	12	14	14	14	16	16	16	18	18	18	20	20	20	20	20	20
China	1	10	12	12	12	14	14	14	16	16	16	18	18	18	20	20	20	20	20	20
Weak		Scenario Rating																		
Country Group	Included Country Number	AAA	AA+	AA	AA-	A+	A	A-	BBB+	BBB	BBB-	BB+	BB	BB-	B+	B	B-	CCC+	CCC	CCC-
First Class	19	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10
Second Class	15	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8
Third Class	61	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5
China	1	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5

Exhibit 10: Standard Recovery Rate Assumptions for Sovereign, Municipal, and Local Government Financing Vehicle (LGFV) (%)

Sovereign Recovery		Scenario Rating																		
Country Group	Included Country Number	AAA	AA+	AA	AA-	A+	A	A-	BBB+	BBB	BBB-	BB+	BB	BB-	B+	B	B-	CCC+	CCC	CCC-
First Class	19	36	38	38	38	40	40	40	46	46	46	49	49	49	50	50	50	50	50	50
Second Class	15	36	38	38	38	40	40	40	46	46	46	49	49	49	50	50	50	50	50	50
Third Class	61	36	38	38	38	40	40	40	46	46	46	49	49	49	50	50	50	50	50	50
China	1	36	38	38	38	40	40	40	46	46	46	49	49	49	50	50	50	50	50	50

Municipal Recovery		Scenario Rating																		
Country Group	Included Country Number	AAA	AA+	AA	AA-	A+	A	A-	BBB+	BBB	BBB-	BB+	BB	BB-	B+	B	B-	CCC+	CCC	CCC-
Muni 1	-	85	86	89	90	91	92	93	94	94	94	96	96	96	97	98	98	98	98	98
Muni 2	-	75	78	80	82	83	85	86	87	88	89	91	92	93	94	95	95	95	95	95
Muni 3	-	60	63	65	67	68	70	71	72	73	74	76	77	78	79	80	80	80	80	80
Muni 4	-	40	45	50	52	53	55	57	57	60	62	63	65	66	68	70	70	70	70	70
Muni 5	-	15	20	25	27	28	30	32	33	35	37	38	40	41	43	45	45	45	45	45

City Investment Recovery		Scenario Rating																		
Country Group	Included Country Number	AAA	AA+	AA	AA-	A+	A	A-	BBB+	BBB	BBB-	BB+	BB	BB-	B+	B	B-	CCC+	CCC	CCC-
LGFV 1	-	85	86	89	90	91	92	93	94	94	94	96	96	96	97	98	98	98	98	98
LGFV 2	-	75	78	80	82	83	85	86	87	88	89	91	92	93	94	95	95	95	95	95
LGFV 3	-	60	63	65	67	68	70	71	72	73	74	76	77	78	79	80	80	80	80	80
LGFV 4	-	40	45	50	52	53	55	57	57	60	62	63	65	66	68	70	70	70	70	70
LGFV 5	-	15	20	25	27	28	30	32	33	35	37	38	40	41	43	45	45	45	45	45

Exhibit 11: Discount Rate Assumptions for Financial Collaterals (%)

Financial Collateral Type	Scenario Rating																		
	AAA	AA+	AA	AA-	A+	A	A-	BBB+	BBB	BBB-	BB+	BB	BB-	B+	B	B-	CCC+	CCC	CCC-
Cash and cash equivalents	1.0	0.8	0.6	0.4	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
AA-/AAA rated (< 1 year) bonds---sovereign entities	12.0	10.8	9.6	8.4	7.2	6.0	5.4	4.8	4.2	3.6	2.9	2.3	1.7	1.1	0.5	0.5	0.5	0.5	0.5
AA-/AAA rated (< 1 year) bonds---non-sovereign entities	19.0	17.6	16.2	14.8	13.4	12.0	10.8	9.6	8.3	7.1	5.9	4.7	3.4	2.2	1.0	1.0	1.0	1.0	1.0
AA-/AAA rated (< 1 year) bonds---structured finance	33.0	30.8	28.6	26.4	24.2	22.0	19.8	17.6	15.3	13.1	10.9	8.7	6.4	4.2	2.0	2.0	2.0	2.0	2.0
AA-/AAA rated (1 to 5 year) bonds---sovereign entities	15.0	13.6	12.2	10.8	9.4	8.0	7.3	6.7	6.0	5.3	4.7	4.0	3.3	2.7	2.0	2.0	2.0	2.0	2.0
AA-/AAA rated (1 to 5 year) bonds---non-sovereign entities	24.0	22.4	20.8	19.2	17.6	16.0	14.7	13.3	12.0	10.7	9.3	8.0	6.7	5.3	4.0	4.0	4.0	4.0	4.0
AA-/AAA rated (1 to 5 year) bonds---structured finance	40.0	37.6	35.2	32.8	30.4	28.0	25.8	23.6	21.3	19.1	16.9	14.7	12.4	10.2	8.0	8.0	8.0	8.0	8.0
AA-/AAA rated (>5 year) bonds---sovereign entities	20.0	18.4	16.8	15.2	13.6	12.0	11.1	10.2	9.3	8.4	7.6	6.7	5.8	4.9	4.0	4.0	4.0	4.0	4.0
AA-/AAA rated (>5 year) bonds---non-sovereign entities	31.0	29.2	27.4	25.6	23.8	22.0	20.4	18.9	17.3	15.8	14.2	12.7	11.1	9.6	8.0	8.0	8.0	8.0	8.0
AA-/AAA rated (>5 year) bonds---structured finance	49.0	46.4	43.8	41.2	38.6	36.0	33.8	31.6	29.3	27.1	24.9	22.7	20.4	18.2	16.0	16.0	16.0	16.0	16.0
BBB-/A+ rated (< 1 year) bonds---sovereign entities	19.0	17.6	16.2	14.8	13.4	12.0	10.8	9.6	8.3	7.1	5.9	4.7	3.4	2.2	1.0	1.0	1.0	1.0	1.0
BBB-/A+ rated (< 1 year) bonds---non-sovereign entities	27.0	25.4	23.8	22.2	20.6	19.0	17.1	15.2	13.3	11.4	9.6	7.7	5.8	3.9	2.0	2.0	2.0	2.0	2.0
BBB-/A+ rated (< 1 year) bonds---structured finance	42.0	40.2	38.4	36.6	34.8	33.0	29.8	26.6	23.3	20.1	16.9	13.7	10.4	7.2	4.0	4.0	4.0	4.0	4.0
BBB-/A+ rated (1 to 5 year) bonds---sovereign entities	25.0	23.0	21.0	19.0	17.0	15.0	13.7	12.3	11.0	9.7	8.3	7.0	5.7	4.3	3.0	3.0	3.0	3.0	3.0
BBB-/A+ rated (1 to 5 year) bonds---non-sovereign entities	35.0	32.8	30.6	28.4	26.2	24.0	22.0	20.0	18.0	16.0	14.0	12.0	10.0	8.0	6.0	6.0	6.0	6.0	6.0
BBB-/A+ rated (1 to 5 year) bonds---structured finance	52.0	49.6	47.2	44.8	42.4	40.0	36.9	33.8	30.7	27.6	24.4	21.3	18.2	15.1	12.0	12.0	12.0	12.0	12.0
BBB-/A+ rated (>5 year) bonds---sovereign entities	33.0	30.4	27.8	25.2	22.6	20.0	18.4	16.9	15.3	13.8	12.2	10.7	9.1	7.6	6.0	6.0	6.0	6.0	6.0
BBB-/A+ rated (>5 year) bonds---non-sovereign entities	45.0	42.2	39.4	36.6	33.8	31.0	28.9	26.8	24.7	22.6	20.4	18.3	16.2	14.1	12.0	12.0	12.0	12.0	12.0
BBB-/A+ rated (>5 year) bonds---structured finance	64.0	61.0	58.0	55.0	52.0	49.0	46.2	43.4	40.7	37.9	35.1	32.3	29.6	26.8	24.0	24.0	24.0	24.0	24.0
BB-/BB+ rated bonds---sovereign entities	60.0	54.0	48.0	42.0	36.0	30.0	28.3	26.7	25.0	23.3	21.7	20.0	18.3	16.7	15.0	15.0	15.0	15.0	15.0
Other rated bonds	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
Insurance policy with cash values of similar financial products	30.0	28.4	26.8	25.2	23.6	22.0	20.7	19.3	18.0	16.7	15.3	14.0	12.7	11.3	10.0	10.0	10.0	10.0	10.0
Gold	20.0	19.6	19.2	18.8	18.4	18.0	17.7	17.3	17.0	16.7	16.3	16.0	15.7	15.3	15.0	15.0	15.0	15.0	15.0
Major index shares and convertible bonds	80.0	76.0	72.0	68.0	64.0	60.0	55.0	50.0	45.0	40.0	35.0	30.0	25.0	20.0	15.0	15.0	15.0	15.0	15.0
Other stocks, convertible bonds and funds listed on the exchange	100.0	98.0	96.0	94.0	92.0	90.0	82.8	75.6	68.3	61.1	53.9	46.7	39.4	32.2	25.0	25.0	25.0	25.0	25.0
Other bonds, stocks and funds	100.0	99.0	98.0	97.0	96.0	95.0	87.8	80.6	73.3	66.1	58.9	51.7	44.4	37.2	30.0	30.0	30.0	30.0	30.0

Exhibit 12: Recovery Rate Assumptions for Non-financial Collaterals (%)

Financial Collateral Type	Required minimum collateralization level	Required level of over-collateralization	Scenario Rating																		
			AAA	AA+	AA	AA-	A+	A	A-	BBB+	BBB	BBB-	BB+	BB	BB-	B+	B	B-	CCC+	CCC	CCC-
Receivables LV1	20	150	30.0	34.0	38.0	42.0	46.0	50.0	51.4	52.8	54.2	55.6	56.9	58.3	59.7	61.1	62.5	62.5	62.5	62.5	62.5
Receivables LV2	30	180	27.0	30.6	34.2	37.8	41.4	45.0	46.3	47.5	48.8	50.0	51.3	52.5	53.8	55.0	56.3	56.3	56.3	56.3	56.3
Receivables LV3	50	200	24.0	27.2	30.4	33.6	36.8	40.0	41.1	42.2	43.3	44.4	45.6	46.7	47.8	48.9	50.0	50.0	50.0	50.0	50.0
Residential real estate and land use right LV1	30	150	45.5	50.4	55.3	60.2	65.1	70.0	71.9	73.9	75.8	77.8	79.7	81.7	83.6	85.6	87.5	87.5	87.5	87.5	87.5
Residential real estate and land use right LV2	50	180	42.3	46.8	51.4	55.9	60.5	65.0	66.8	68.6	70.4	72.2	74.0	75.8	77.6	79.4	81.3	81.3	81.3	81.3	81.3
Residential real estate and land use right LV3	40	180	32.5	36.0	39.5	43.0	46.5	50.0	51.4	52.8	54.2	55.6	56.9	58.3	59.7	61.1	62.5	62.5	62.5	62.5	62.5
Commercial real estate and land use right LV1	50	200	39.0	43.2	47.4	51.6	55.8	60.0	61.7	63.3	65.0	66.7	68.3	70.0	71.7	73.3	75.0	75.0	75.0	75.0	75.0
Commercial real estate and land use right LV2	50	200	33.0	37.4	41.8	46.2	50.6	55.0	56.5	58.1	59.6	61.1	62.6	64.2	65.7	67.2	68.8	68.8	68.8	68.8	68.8
Commercial real estate and land use right LV3	50	220	27.0	30.6	34.2	37.8	41.4	45.0	46.3	47.5	48.8	50.0	51.3	52.5	53.8	55.0	56.3	56.3	56.3	56.3	56.3
Machinery equipment LV1	30	180	36.0	40.8	45.6	50.4	55.2	60.0	61.7	63.3	65.0	66.7	68.3	70.0	71.7	73.3	75.0	75.0	75.0	75.0	75.0
Machinery equipment LV2	50	200	24.0	27.2	30.4	33.6	36.8	40.0	41.1	42.2	43.3	44.4	45.6	46.7	47.8	48.9	50.0	50.0	50.0	50.0	50.0
Earning right LV1	30	180	27.0	30.6	34.2	37.8	41.4	45.0	46.3	47.5	48.8	50.0	51.3	52.5	53.8	55.0	56.3	56.3	56.3	56.3	56.3
Earning right LV2	50	200	24.0	27.2	30.4	33.6	36.8	40.0	41.1	42.2	43.3	44.4	45.6	46.7	47.8	48.9	50.0	50.0	50.0	50.0	50.0
Other collateral	50	250	24.0	27.2	30.4	33.6	36.8	40.0	41.1	42.2	43.3	44.4	45.6	46.7	47.8	48.9	50.0	50.0	50.0	50.0	50.0

Appendix 4: Default Timing Assumptions

Exhibit 13: Default Timing Assumptions (%)

Front-Loaded Default Pattern Assumptions										
Year	WAL 0.5-1.5	WAL 2-2.5	WAL 3-3.5	WAL 4-4.5	WAL 5-5.5	WAL 6-6.5	WAL 7-7.5	WAL 8-8.5	WAL 9-9.5	WAL 10+
1	100	75	50	40	40	35	35	30	30	25
2	-	25	25	30	20	20	20	20	15	15
3	-	-	25	20	20	15	15	15	10	10
4	-	-	-	10	10	10	10	10	10	10
5	-	-	-	-	10	10	10	10	10	10
6	-	-	-	-	-	10	5	5	10	10
7	-	-	-	-	-	-	5	5	5	5
8	-	-	-	-	-	-	-	5	5	5
9	-	-	-	-	-	-	-	-	5	5
10	-	-	-	-	-	-	-	-	-	5

Mid-Loaded Default Pattern Assumptions										
Year	WAL 0.5-1.5	WAL 2-2.5	WAL 3-3.5	WAL 4-4.5	WAL 5-5.5	WAL 6-6.5	WAL 7-7.5	WAL 8-8.5	WAL 9-9.5	WAL 10+
1	100	50	25	20	15	10	5	5	5	5
2	-	50	50	30	20	15	15	10	5	5
3	-	-	25	30	30	25	25	10	10	10
4	-	-	-	20	20	25	25	25	25	10
5	-	-	-	-	15	15	15	25	25	20
6	-	-	-	-	-	10	10	10	10	20
7	-	-	-	-	-	-	5	10	10	10
8	-	-	-	-	-	-	-	5	5	10
9	-	-	-	-	-	-	-	-	5	5
10	-	-	-	-	-	-	-	-	-	5

Back-Loaded Default Pattern Assumptions										
Year	WAL 0.5-1.5	WAL 2-2.5	WAL 3-3.5	WAL 4-4.5	WAL 5-5.5	WAL 6-6.5	WAL 7-7.5	WAL 8-8.5	WAL 9-9.5	WAL 10+
1	100	25	25	20	15	10	5	5	5	5
2	-	75	25	20	15	10	10	5	5	5
3	-	-	50	30	20	15	10	5	5	5
4	-	-	-	30	25	20	10	10	10	10
5	-	-	-	-	25	20	20	10	10	10
6	-	-	-	-	-	25	20	20	10	10
7	-	-	-	-	-	-	25	20	10	10
8	-	-	-	-	-	-	-	25	20	10
9	-	-	-	-	-	-	-	-	25	15
10	-	-	-	-	-	-	-	-	-	20

Exhibit 13: Default Timing Assumptions (%) (continued)

Year	Flat Default Pattern Assumptions									
	WAL 0.5-1.5	WAL 2-2.5	WAL 3-3.5	WAL 4-4.5	WAL 5-5.5	WAL 6-6.5	WAL 7-7.5	WAL 8-8.5	WAL 9-9.5	WAL 10+
1	100	50	33	25	20	16	14	12.5	11	10
2	-	50	33	25	20	16	14	12.5	11	10
3	-	-	34	25	20	17	14	12.5	11	10
4	-	-	-	25	20	17	14	12.5	11	10
5	-	-	-	-	20	17	14	12.5	11	10
6	-	-	-	-	-	17	15	12.5	11	10
7	-	-	-	-	-	-	15	12.5	11	10
8	-	-	-	-	-	-	-	12.5	11	10
9	-	-	-	-	-	-	-	-	12	10
10	-	-	-	-	-	-	-	-	-	10

Related Criteria

- General Structured Finance Rating Criteria, 18 February 2019

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