

CLOs and Corporate CDOs Rating Criteria

Sector-Specific

Scope

This Criteria report details Fitch Ratings' methodology for analysing portfolios of corporate credit for rating collateralised loan obligations (CLOs) and other collateralised debt obligations (CDOs). The report outlines the qualitative and quantitative factors considered in Fitch's analysis of portfolios of corporate credit.

These criteria apply to the rating of combination notes where the underlying tranches are CLOs or corporate CDOs and provide the framework for rating project finance CDOs. The criteria are applicable for new issue ratings and surveillance of existing ratings.

The Fitch Portfolio Credit Model (PCM) is the main tool for analysing the credit risk of project finance credit portfolios. The default probability assumptions and recovery rates are based on asset-specific Credit Opinions and Recovery Ratings (RRs) provided by Fitch's global infrastructure group. Portfolio default rates are based on bespoke correlation assumptions.

Key Rating Drivers

The order of the following Key Rating Drivers for these criteria reflects their relative importance for CLOs and CDOs, for which asset credit quality is the most important.

Asset Credit Quality: Asset quality is a primary driver of the default probability of the underlying corporate assets. Asset quality is based on the corporate Issuer Default Rating (IDR) and term.

Asset Security: Asset security is determined by the seniority of the corporate obligation and includes the jurisdiction of the issuer. Asset security is the main driver of recovery rate assumptions. Average recovery rates, based on historical market data, may be applied in the absence of explicit asset RRs or recovery estimates provided by Fitch's corporate group.

Portfolio Composition: Portfolio performance, in terms of portfolio default rates, depends on the level of diversity by industry and obligor, and geographic concentrations, which determine the expected volatility in portfolio default rates. The key volatility parameter for credit portfolio performance is correlation.

Portfolio Management: Portfolio management and trading may result in an evolving portfolio credit profile, extension risk and other portfolio changes not represented by the closing portfolio. The investment guidelines and permitted management terms are analysed to evaluate the risk factors of a managed portfolio.

Cash Flow Analysis: CLO and CDO structural features and hedging strategies, and the timing of defaults and recoveries, are important considerations in cash flow modelling and have a meaningful impact on their performance.

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This report updates and replaces *CLOs and Corporate CDOs Rating Criteria*, dated 30 March 2023.

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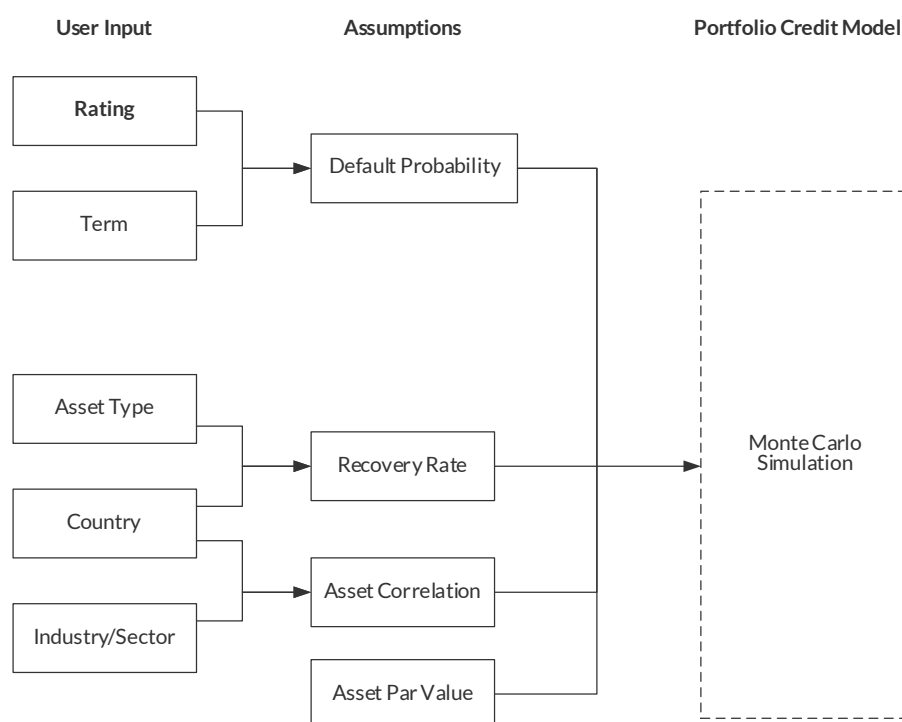
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Quantitative Models and Data

Fitch's main tool in assessing the primary rating factors of corporate CLOs and CDOs is the Fitch PCM, which is available for [download on Fitch's website](#). The model is updated from time to time, and a release log is maintained on the site to indicate the updated features and assumptions. A description of the source data used to derive the assumptions is detailed in each section of this report. Additionally, numbers shown throughout this report may be rounded to the decimal displayed.

Overview of the Portfolio Credit Model Process



Source: Fitch Ratings

The PCM is used for analysing the joint default behaviour within credit portfolios. The model is based on the Gaussian copula function, which is based on the multivariate normal distribution. An important benefit of the Gaussian copula is its analytical tractability. The dependence structure is fully described by the pair-wise linear correlation assumption. For example, zero correlation in the Gaussian copula means all default events are independent.

The two main functions of the model are: mapping generic issuer and asset attributes to corresponding default probability and recovery rate assumptions; and generating portfolio default rate and loss rates for each rating scenario as multiples of the base default rate and loss rate. The key output of the model is the distribution of possible portfolio default rates and loss rates. The distribution mean is equal to average default probability weighted by asset notional amount.

The portfolio performance is uncertain and can deviate significantly from expectations. The volatility of possible portfolio default rates depends on the portfolio composition. Diversified portfolios, in terms of number of obligors, industry or region would be expected to show lower volatility and hence default rates that are closer to the expected case. In contrast, more concentrated portfolios would be expected to exhibit more volatile default rates.

The Gaussian copula only has one volatility parameter, which is correlation. Higher correlation corresponds to more volatile portfolio default rates, which is reflected in a model distribution with fatter tails. In other words, portfolio default rates that are significantly higher than the expected default rate are more likely.

Related Criteria

[Corporates Recovery Ratings and Instrument Ratings Criteria \(April 2021\)](#)

[Global Structured Finance Rating Criteria \(March 2023\)](#)

[Single- and Multi-Name Credit-Linked Notes Rating Criteria \(January 2023\)](#)

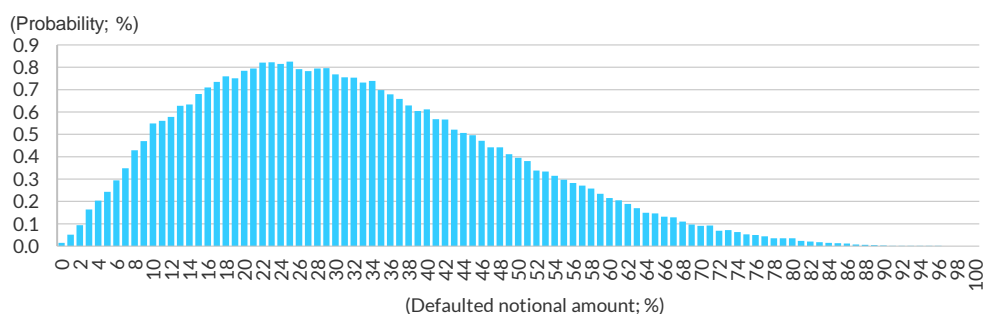
[Structured Finance and Covered Bonds Interest Rate Stresses Rating Criteria \(December 2022\)](#)

[Structured Finance and Covered Bonds Counterparty Rating Criteria \(March 2023\)](#)

Related Research

[Fitch CLO Criteria Assumptions Update Explained \(September 2021\)](#)

Default Distribution – Probability Mass Function



Source: Fitch Ratings

The portfolio default rate, or rating default rate (RDR), and loss rate, or rating loss rate (RLR), assumptions for each rating level are determined as percentiles of the default and loss distribution. The percentile levels are based on CDO target default rates, as explained below.

Rating Determination

CLO ratings are determined by a rating committee that considers the model-implied rating (MIR) in its determination process.

For newly assigned ratings and upgrades of notes of CLOs continuing to reinvest, MIRs are based on analysis described in the section *Fitch Stressed Portfolio*. The reinvestment status of a CLO is not based solely on whether a CLO has formally reached the end of its reinvestment period; the rating committee considers whether the CLO is likely to continue reinvesting post the end of its reinvestment period, based on the CLO's performance against relevant tests.

Fitch reviews the provisions of transaction governing documents when assigning initial ratings. Additional stress in the rating analysis may be applied when credit committee determines that documents include features that present material additional credit risk. In such instances, Fitch will publish any additional stress in transaction research.

For existing ratings not considered for an upgrade, the analysis is based on the actual portfolio.

For static CLOs, and CLOs that are post their reinvestment period and are unlikely to continue reinvesting, the basis for deriving MIRs is described in the section *Static Portfolio Considerations*.

The MIR is a key input to the rating committee determination, although assigned ratings may differ from the MIR in the following situations.

- Note ratings are subject to a rating cap, as defined in the related criteria, and this rating cap is not factored into the MIR. In this case, the note rating will be the lower of the rating cap and the MIR.
- For new ratings and upgrades of existing ratings above the MIR, Fitch can assign a rating higher than the MIR provided that all of the following conditions are met:
 - i. The assigned rating is no more than one notch higher than the MIR;
 - ii. Any excluded cash flow scenarios do not reflect Fitch's immediate expectations; and
 - iii. In the case of replenishing structures, the current portfolio is passing at the assigned rating of the CLO notes.

The foregoing applies to existing CLO transactions subject to refinancing with any material credit negative covenant changes and is applicable to both new and existing ratings, in the case of partial refinancing of the transaction.

- Fitch may assign or maintain a rating on a note at a rating level as much as three notches below the MIR. The occurrence and basis of such decisions may include consideration of the magnitude of the difference between the break-even default rate (BDR) and the hurdle rate at the assigned rating, and the frequency of scenarios in which the BDR exceeds the hurdle rate.

Model-Implied Rating

Represents the highest rating at which the note is passing all stress scenarios in the modelling.

- The rating committee may determine a rating in the range of 'Csf' to 'B-sf' based on Fitch's rating definitions. For example, a 'CCCsf' rating would be assigned if the committee believes there to be a 'real possibility of default', while a 'B-sf' rating would reflect a 'limited margin of safety'. Additionally, a rating committee may assign a new rating of 'B-sf' if (i) the actual or indicative portfolio analysis for the class passes the RDR at 'Bsf' or (ii) the actual or indicative portfolio analysis for the class, analysed with the transaction minimum and maximum fixed-rate allowance (see *Cash Flow Stresses*), passes the RDR at 'B-sf', to ensure a minimum cushion at the 'B-sf' rating. In such cases, Fitch would typically not perform a stressed portfolio analysis for the 'B-sf' rating level.

For Existing Ratings, the Committee can Assign Ratings that are Different from the MIR if:

- The committee believes there is a significant likelihood that a rating action may be reversed in the near term due to potentially volatile performance; or
- The committee has concerns about specific sectors/issues that the committee believes are not adequately addressed under the methodology; or
- Certain cash flow scenarios do not reflect Fitch's immediate expectation. For example, in a very low or negative interest rate environment, the scenarios associated with rising interest rates. The assigned ratings cannot be more than three notches higher or lower than the MIR.

Specific Examples of Deviation from the MIR in Surveillance Include the Following:

- The committee could decide not to upgrade to the MIR if the transaction is exposed to significant concentration risk. The committee would base the decision to assign a different rating from the MIR on sensitivity analysis, which assumes additional stresses for one or more of the largest performing obligors.
- The committee expects near-term asset pre-payments to counter credit deterioration, maintaining the rating above the MIR. The committee would base the rating decision on sensitivity analysis that incorporates, for example, historically observed pre-payment spikes.
- The committee could also assign a different rating from the MIR or change the Rating Outlook or Rating Watch on the basis of sensitivity analysis, which incorporates additional stresses to certain issuers and/or sectors. This may occur if the committee believes these issuers and/or sectors may be subject to near-term performance volatility that is not adequately addressed under the standard recovery and default assumptions.

A Deviation from the MIR for New Issue Ratings or Surveillance Ratings May Include the Following:

- The committee may apply a multiplier of less than 100% to various recovery assumptions to align with updated expectations for recovery prospects. This could be precipitated by a drop in the average RR for Fitch-rated securities held in CLOs or by an expectation of below-average recoveries for a specific period. In any case, Fitch will communicate the assumptions in its Rating Action Commentary.

Asset Credit Quality

Asset Default Probabilities

Fitch uses "rating" and "term" as the primary determinants of an asset's expected default probability. There is a substantial history of data related to the default experience of a wide spectrum of corporate entities, rated over four decades. Fitch uses the corporate default rates made available by all three major rating agencies. This data set reflects the broadest set of default statistics available, and minimises the risk of any variances in ratings approach or industry coverage.

The rating is based on the Fitch IDR or Fitch Issuer Default Credit Opinion, together, referred to herein as the Fitch IDR, provided by Fitch's corporate or financial institutions ratings group. In the absence of a Fitch IDR, we may use public ratings from Moody's Corporation or S&P

In this report, the terms Fitch Issuer Default Rating or Fitch Issuer Default Credit Opinion will be referred to together as the Fitch IDR.

Global Inc. For a detailed description of the Fitch IDR Equivalency Rating derivation, see *Appendix 5*.

Rating Mapping for Mid-Cap Portfolios

Mid-cap borrowers do not have public ratings and it is often not practically feasible to assign Credit Opinions due to the size of the portfolios (100+ companies). This section applies only to borrowers for which no Fitch IDR Equivalency, as outlined in *Appendix 5*, can be established. Historical data shows few defaults despite spanning a significant period, making it impossible to infer a default probability based on that data alone.

For bank balance sheet portfolios, the originating bank would typically use a bank internal rating model to assess the borrower's credit risk. The bank may be able to provide a comparison of the bank internal ratings to available agency ratings because it either applies the model to its larger customers or, for internal back-testing, the bank may have run a sample of larger companies with available financial data through its rating model.

For granular portfolios with more than 100 borrowers, where at closing the largest borrower represents less than 1.5% of the portfolio, Fitch may assess the credit quality based on financial ratios and the bank's internal rating tool. We will first determine the average credit quality of the portfolio at a rating category level, which will be no higher than 'BB'. Financial ratios of the borrowers and a rating mapping correlation will both be considered to establish the average credit quality of the securitised portfolio on a rating category basis.

For example, Fitch expects financial ratios such as total debt/EBITDA to be comparable with, or better than, the ones reported in Fitch's *Leveraged Loan Chart Book* for borrowers in the same jurisdiction. We would perform a rating mapping between Fitch, S&P or Moody's and the bank internal rating model, based on the available sample comparison, to distribute the ratings around the established average credit quality of the portfolio.

This rating methodology for mid-cap portfolios will only be used if all conditions below are satisfied:

- Only for bank-originated portfolios where the bank retains a large share on the balance sheet.
- Minimum of five years of historical default history and performance in line with, or better than, the expected performance based on the rating mapping.
- Bank internal rating model subject to regulatory approval, typical for an internal ratings-based approach, for capital relief purposes, and ratings updated frequently, typically within 12 months. Fitch will assess the performance of models by looking at the volatility of rating transition matrices and will analyse the bank's processes to validate its internal rating model.
- Only for portfolios primarily comprising first-lien senior-ranking loans that have been tested through a credit cycle. The securitised portfolios must be broadly in line with the bank balance sheet and be reasonably diverse in terms of number of obligors and obligor exposure.

The surveillance approach for transactions rated under this framework will primarily rely on the rating mapping but the portfolio average rating will be capped at the rating level established at closing. If the correlation between Fitch, S&P or Moody's and the bank internal rating model remains relatively unchanged since closing, and the transaction is performed in line with Fitch's initial expectation, the rating mapping established at closing will be used for the transaction review.

However, if the average credit quality inferred from the initial mapping is higher than at closing then the rating mapping will be adjusted downward so that the average portfolio rating corresponds to the one established at closing.

CDO Target Default Probabilities

Fitch's CDO ratings correspond to a value at risk (VaR) measure, which looks primarily at the probability of exceeding available credit enhancement, the exceedance probability, usually expressed by the level of confidence, and determined as one minus the exceedance probability.

For credit risk management under the Basel regulation, the level of confidence is usually chosen to be 99.99%, or 1bp probability of exceeding the VaR. A single confidence level is not sufficient to differentiate between different rating categories. The risk tolerance for each rating level and term is determined by CDO target default rates. The table shows the one- and 10-year CDO target default rates used in the model.

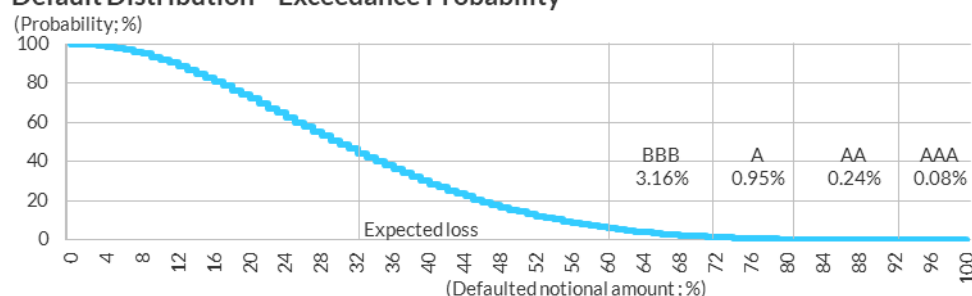
One-Year and 10-Year CDO Target Default Probabilities

	CDO Target DP (%) 1 Year	Confidence Level (%) 1 Year	CDO Target DP (%) 10 Years	Confidence Level (%) 10 Years
AAAsf	0.01	99.99	0.08	99.92
AAsf	0.01	99.99	0.24	99.76
Asf	0.02	99.98	0.95	99.05
BBBsf	0.20	99.80	3.16	96.84
BBsf	1.05	98.95	11.84	88.16
Bsf	3.81	96.19	23.67	76.33

CDO – Collateralised debt obligation. DP – Default Probability
Source: Fitch Ratings

For example, the corresponding CDO rating for a 99.99% confidence level over one year would be 'AAAsf'. In contrast, for a 'BBsf' rating over one year, the target CDO default rate is much higher, yielding a lower confidence level of 98.95%.

Default Distribution - Exceedance Probability



Source: Fitch Ratings

The chart above illustrates the VaR measure graphically. The curve, which is derived from the portfolio loss distribution, shows the probability of exceeding a certain level of portfolio losses. This allows one to determine the VaR directly from the respective risk tolerance levels or CDO default rates. For credit risk management, the risk horizon is usually one year. CDOs have a much longer risk horizon, of between three and 10 years. Generally, the risk tolerance expressed in the CDO target default rates increases for longer risk horizons. Since the assets in CDO portfolios may have different maturity dates or even amortisation schedules, risk tolerance is determined by the weighted average life (WAL) of the CDO portfolio.

As this applies to the rated notes, Fitch's approach applies target default probabilities equal to the input default probabilities for all rating categories below the 'Asf' category. The approach applies target default probabilities lower than the input default probabilities for the rating categories 'AAAsf', 'AAsf' and 'Asf'. As stated in the prior section, Fitch looks to long-term empirical statistics for its input default probabilities. The sample size of the data cohorts for the 'AAAsf', 'AAsf' and 'Asf' categories contained fewer observations relative to the other observed cohorts. Fitch believes it is prudent to reduce the target default probability and, therefore, raise the confidence level, when determining the level of support necessary to achieve these highest of ratings.

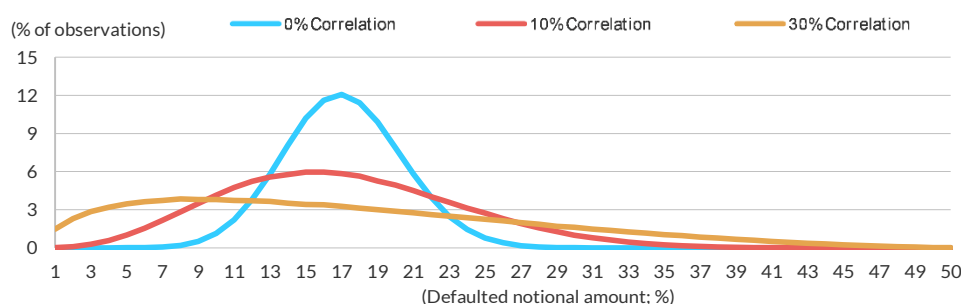
Correlation Framework – Benchmarking to Historical Peak Default Rates

The correlation assumption in PCM is the parameter that determines the volatility of possible portfolio default rates and the resulting multiple of RDRs relative to the mean assumption. The model is able to produce different multiples as a function of portfolio diversity and mean assumption. For example, multiples produced by PCM increase for portfolios that are more

concentrated by industry or number of obligors. Similarly, multiples produced by the model decrease as the mean assumption increases.

The chart below shows the effect of correlation on the portfolio default distribution. Fitch has calibrated a correlation framework to match the model-implied volatility of portfolio default rates to the historically observed default rate volatility. More details of the calibration methodology are in *Appendix 3*. We view this as important that the model output can be tied to a fundamental view of credit risk. A primary expectation is CDO notes carrying an investment-grade rating should perform robustly as a cohort, even in periods of peak corporate default rates. Fitch believes CDO notes rated in the 'Asf' category and above should not default in a stress with similar severity as the recessions that generated the historic peak default rates.

Effect of Portfolio Correlation



Source: Fitch Ratings

This concept of back-testing and benchmarking the model output against multiples of historical default data is an important concept in understanding the rationale for how correlation was set, and has the effect of embedding some explicit and easy-to-understand deterministic overlays onto the simulation-derived results.

Portfolio Default Rate and Model Output Coverage

	BBB (RDR) Peak 9.3%			BB (RDR) Peak 28.8%			B (RDR) Peak 47.9%		
	Peak		30% Single	Peak		30% Single	Peak		30% Single
(%)	Diverse	Portfolio	Industry	Diverse	Portfolio	Industry	Diverse	Portfolio	Industry
AAAsf	16.0	17.3	19.3	37.7	39.7	41.3	56.7	58.7	60.0
AAsf	13.7	14.7	16.0	34.0	35.7	37.0	52.7	54.7	55.7
Asf	11.0	11.7	12.3	29.0	30.3	31.7	47.3	48.7	50.0
BBBsf	8.7	9.0	9.3	24.7	25.3	26.3	41.7	43.0	43.7
BBsf	6.0	6.0	6.0	19.0	19.3	19.7	34.3	35.0	35.3
Bsf	4.3	4.3	4.3	15.3	15.7	15.7	29.7	30.0	30.0
Expected	3.2	3.2	3.2	11.8	11.8	11.8	23.7	23.7	23.7

RDR – Rating Default Rate.

Source: Fitch Ratings

Industry and Regional Diversity

Fitch further believes that credit portfolios that are less diversified, with higher concentrations in terms of industry and region compared with the cohort portfolio underlying the base calibration, could exhibit higher volatility of default rates relative to the mean assumption. The correlation framework was extended to differentiate correlation levels between industries and within a single industry and between regions and within regions. Available historical data was not detailed enough to compute cohort default rates for portfolios with different industry and regional composition. The correlation levels were calibrated to differentiate the RDR between calibration portfolios with higher levels of industry and regional concentration compared with the cohort portfolio (see *Appendix 3*).

The final correlation framework seeks to differentiate CDO portfolio concentrations that may affect performance. The framework does this through a combination of four correlation

adjustments. There is a base level of correlation applied to all assets. The second layer is a sector correlation applied to assets from the same sector. The third layer is an industry correlation applied to assets from the same industry. Finally, the fourth correlation adjustment is applied to the largest obligors in the portfolio to stress for obligor concentrations.

The framework groups industries into six sectors, each containing one to nine industries. The example in the *Correlation Framework* table refers to a US portfolio. The base level of correlation is set to 6%, with a 2% correlation and a total correlation of 8% between assets in the same sector. If assets are also in the same industry class within a sector, the correlation is assumed to be even higher, set at 28%. The deepest empirical data set on defaults is available only for the US and, therefore, not representative of multi-country diversity. However, Fitch believes there is a significant level of regional diversification within the US.

In order to vary correlation assumptions to reflect geographic diversity or concentration, Fitch began with the following guiding principles:

- Advanced-economy countries smaller than the US would not benefit from the same level of regional diversification. Therefore, the base correlation between companies in countries other than the US should be higher than the 6% US assumption.
- The global economy results in a relatively limited benefit within a region. For example, a portfolio diversified within western Europe should not yield materially different portfolio default rates than a US portfolio.
- Different industries benefit from geographic diversification to varying degrees.

With these guiding principles, the correlation framework is applied, with a base level of correlation for issuers located in different regions, with add-ons for commonality of country, sector and industry.

Correlation Framework

(%)	Base Level ^{a,b}	Sector Add-On	Industry Add-On (%)
Same Country	10 (6 if US)	+2	+20
Same Region, Different Countries	6	+2	+20
Different Regions	4	+2	+20
Banking and Finance Assets	As above	+14	8

^a Includes global base of 4% plus regional uplift of 2% and country uplift of 4% (except US where country uplift is 0%).

Note: For a full list of countries and industries in the portfolio credit model, see *Appendix 3*.

^b Except Greece, which has a country uplift of 5% and; therefore, a base level correlation of 11%.

Source: Fitch Ratings

Sovereign-Related Risk

Transactions may have partial exposures to countries where the Country Ceiling is below the highest rating of the notes and/or where Fitch applies a cap to its structured finance ratings, pursuant to the *Structured Finance and Covered Bonds Country Risk Rating Criteria*. Currently, this is the case for the Fitch-rated high-yield CLOs with exposure to peripheral Eurozone countries, such as Italy, Portugal and Greece, which follows the *Structured Finance and Covered Bonds Country Risk Rating Criteria*.

The updated correlation and recovery assumptions would be calibrated to match the expected loss at the country rating cap level to the 'AAAsf' level. The Country Ceiling for these countries is currently below the highest rating Fitch can assign to the senior notes in high-yield CLOs. Therefore, in line with the *Structured Finance and Covered Bonds Country Risk Rating Criteria*, we assume a possible exit of these countries from the Euro in rating scenarios above the Country Ceiling. This would cause, at the very least, significant performance volatility for underlying borrowers, currency transfer and convertibility (T&C) issues and FX risk for any proceeds from outstanding loans.

Fitch believes the borrowers would likely default in such a scenario and as a result the T&C and FX risk following a Euro exit would primarily apply to any recovery proceeds. We apply a haircut to the recovery proceeds of 50% to assets from these countries at rating levels above the

relevant Country Ceiling in order to address the possible FX risk that could result from the depreciation of a new currency following redenomination of loans.

For example, for a European CLO with a 20% investment limit in countries with a Country Ceiling below 'AAA', or a sovereign rating below 'A-', the usual projected default rate for the 'AAAsf' scenarios is about 60%. This would be assumed to include a 20% exposure to Italy, which is currently the only country with a Country Ceiling below 'AAA' with significant volumes of outstanding leveraged loans. The remaining 40% of defaults would be spread across other countries, which is consistent with Fitch's typical 'AAAsf' default expectations for portfolios not exposed to countries with a Country Ceiling below the target rating. The total default rate assumption would remain unchanged in this instance.

The expected recovery rate at a 'AAAsf' rating for the 20% exposure bucket would be reduced by 50% assuming a depreciation of the new currency to the Euro. As a result, the aggregate recovery assumption for a 'AAAsf' rating scenario for a typical second-generation CLO would decline to 29% from about 35%. The haircut for T&C and FX risk and additional stresses to correlation or recoveries are not included in the PCM model analysis and need to be applied separately to the model results.

However, European CLOs are generally precluded from investing in large exposures to countries with a Country Ceiling lower than 'AAA'. Fitch considers the redenomination risk and country risk in second-generation European CLOs with the typical limit of 10% or lower a secondary risk. For example, the 'AAA' recovery rate would go down to 32% from 35%, with a minimal effect on the BDRs. Therefore, we would not apply any additional stresses during the rating process for a typical European CLO. This may change as the Country Ceilings, the loan market (more issuance from new countries) or the CLO limitations change.

Additional stresses contemplated in the *Structured Finance and Covered Bonds Country Risk Rating Criteria* are generally not applied during the rating process for typical US CLOs, which are generally precluded from investing in companies domiciled in peripheral eurozone countries. Therefore, T&C risk would not be considered a risk factor in these instances.

Emerging Markets

The correlation framework within PCM was further developed to incorporate assets from emerging market (EM) countries and reflect the following additional expectations. Corporate credit portfolios in EM countries are likely to have more volatile portfolio default rates, indicating a higher level of correlation than similarly rated portfolios in advanced economies, regardless of region and country. Therefore, the criteria apply a 7% uplift to the correlation of any two EM assets.

Regional diversity is particularly important for portfolio performance within EMs and, as a result, EM assets from the same region are subject to an additional 10% correlation uplift. Fitch created four broad EM regions to implement this: EM Americas, EM Asia, EM Europe and Central Asia, and EM Africa and the Middle East. Country diversity within the same region is of lesser benefit than regional diversity and assets from the same country are subject to an additional 5% correlation uplift. The same approach with regard to industry concentration apply to EM and advanced economies.

Fitch believes a small amount of EM exposure in a well-diversified portfolio of debt from advanced economies should add geographical diversity and reduce volatility. However, it is our view large EM exposures increase the risk to the portfolio, especially in high rating scenarios, and this outweighs any diversity benefits. By way of illustration, the correlation between Russian assets in different sectors is 26%. This is made up from the sum of 4% global base correlation, 7% EM base correlation, 10% EM region correlation and 5% EM country correlation. By comparison, the correlation between US companies would be 6%, or 4% global base and 2% for being in the same region.

EM Geographical Correlation Framework

Global base level	Location				Total EM Add-On
	EM base Add-On	EM region Add-On	EM country Add-On		
Same EM Country	+4	+7	+10	+5	+26
Same EM Region and Different EM Countries	+4	+7	+10	+0	+21
Different EM Regions	+4	+7	+0	+0	+11

EM – Emerging market. Note: Fitch would also apply sector and industry correlation uplifts of 2% and 20%, respectively, in line with the advanced economy table above.

Source: Fitch Ratings

If the Russian assets are also in the same industry, they will attract a further uplift up to 22%, which would give a total correlation for such a portfolio of 48%. For EM assets from different geographical regions and sectors, for example, a Russian utilities company and an Indonesian finance company, the correlation will be 11%, i.e. 4% global base plus 7% EM base.

Transactions with a material share of EM assets with high regional concentration are unlikely to support 'AAA's' ratings, especially if many of the assets are from low-rated sovereigns. Such concentrated structures, and single-country EM transactions, will be subject to specific rating caps as listed in our *Structured Finance and Covered Bonds Country Risk Rating Criteria*. The correlation framework may be adjusted through a criteria variation to further reflect any specific risks or protections related to the underlying portfolio. A similar approach will be used for transactions where ratings are only assigned on a national scale, where the correlation framework will also be amended to reflect the particularities of the relevant jurisdiction.

Asset Security

Observations from the high-yield default period in 2009 highlighted the pro-cyclical nature of defaults and recoveries, with lower recoveries occurring during periods of higher defaults. Fitch incorporates pro-cyclicality by applying lower recovery for higher rating scenarios. For defaulted securities, we may also consider the post-default trading prices and any feedback received from the manager, when deciding the applicable recovery assumptions.

Corporate Recovery Ratings

RRs and recovery estimate values provided by Fitch's corporate ratings group are a good indicator of future average recovery prospects for typical CLO portfolios on a diverse portfolio basis, across multiple cycles. Absent asset-specific RRs issued by Fitch, fundamental characteristics, such as seniority level, security, jurisdiction, issuer and industry idiosyncratic characteristics, are the main drivers of recoveries.

Fitch's RRs scale provides market participants with additional recovery information for all entities whose IDR is 'B+' and below. RRs range from 'RR1', which indicates an outstanding level of recovery, to 'RR6', which reflects a poor recovery. Fitch's RRs largely represent ultimate recoveries following the work-out process. In addition to RRs, our corporate ratings group may also conduct a bespoke analysis indicating specific recovery estimate values that may be used in our analysis of a typical diverse portfolio CDO. More information on Fitch RRs is available in our *Corporates Recovery Ratings and Instrument Ratings Criteria*.

Seniority

In the absence of asset-specific RRs or recovery estimates, Fitch generally looks to the seniority and security of the actual debt instrument as its primary indicator for the recovery prospects in its analysis of a CDO portfolio. Fitch will assign a recovery rate category corresponding to our view on the asset's recovery prospects, if asset-specific recovery rate assumptions from Fitch's corporate credit analysts are not available.

The categories describing the relative recovery prospects are included in *Appendix 4*. Categorisation will primarily be based on the seniority of the actual debt instrument, with senior secured loans generally corresponding to "strong recovery prospects" and senior unsecured bonds corresponding to "moderate recovery prospects". Senior secured bonds correspond to

their named category, which is equal to an RR of 'RR3'; this is due to lower historical observed recovery rates for bonds compared with senior secured loans. Other debt instruments, including second-lien loans, will commonly be categorised as having weak recovery prospects.

However, where actual recovery experience is less than might be expected for the level of seniority, a lower categorisation may be used in specific cases. For example, for Japan the recovery rate for senior unsecured debt has been below 'moderate' recovery rates. As a result, Fitch would apply a 'weak' recovery rate for senior unsecured debt in Japan.

Furthermore, seniority and security do not fully explain Fitch's recovery expectations for any given asset. The distribution of current US corporate RRs by seniority shows wide variance in the recovery expectations as this may be due to issuer-, industry- or market-related factors. Issuer-specific factors include financing decisions on optimal capital structures by management. Other factors may affect the recovery prospects for particular companies operating in specific industries.

From time to time, there may be macro-factors affecting the types of debt instruments available to issuers. There were limited financing options in 2009-2010, resulting in many companies issuing senior secured bonds to refinance existing loan facilities. The future recovery prospects for these bonds will likely vary, based on the security and covenant protections associated with the debt instrument.

Therefore, the portfolio composition and associated recovery prospects of the underlying assets are reviewed by the relevant credit analyst as part of the CDO rating process. Fitch will make adjustments to the recovery category classification to reflect our forward-looking view on the recovery prospects for each asset in the portfolio, if deemed necessary.

Jurisdictional Considerations

Another important determinant of recovery prospects is jurisdiction. Fitch determined country groupings, based on comparable levels of expected recoveries. Obligors from Group 1 countries, see the *Corporate Recovery Rate Assumptions* table and Appendix 4, are mostly expected to exhibit recovery prospects consistent with those of US obligors, while Group 2 and Group 3 are expected to exhibit decreasing levels of recovery. A full list of Fitch's base recovery assumptions and the tiering applied at different CDO rating stresses can be found in Appendix 4. Finally, Fitch may use additional information, such as the notching differential between the instrument rating and IDR, to better inform its decision on the recovery assumption for any given asset.

Pro-Cyclical Nature of Defaults and Recoveries

Fitch's default and recovery studies show that, while the average recovery for a given seniority has been very variable over time, the relationship of recoveries by seniority generally holds true over time. Market-wide systemic factors play a role in the well-established inverse relationship between default rates and recovery rates, whereby low recovery rates are associated with high default rates.

Fitch stresses the recovery rate assumptions in higher rating stresses to account for the pro-cyclical nature of defaults and recoveries. Recovery observations from the most recent peak default period were more in line with the modelling assumptions used at high rating stresses. As stated earlier in this report, Fitch believes CDO notes rated in the 'Asf' category and above should still be expected to perform in periods of peak default rates. For this reason, the recovery assumptions for 'Asf' stresses are set to match observed recoveries from peak default periods during the three years starting in 2008 for the financial crisis.

Obligor Concentrations

Portfolios with a small number of assets, or those where individual asset balances represent a disproportionate exposure within the portfolio, carry the risk the portfolio performance may be adversely impacted by a few assets that may under-perform expectations based on ratings and debt characteristics. Fitch's methodology applies additional stresses, called the obligor concentration uplift (OCU), to certain inputs to mitigate the risk to CDO portfolio performance posed by outsized assets.

For example, individual assets may recover less upon default than expected based on historical average recovery rates for individual debt classes. Outsized individual assets experiencing low

recoveries will cause them to erode a disproportionate amount of support available to rated noteholders. To take this into account, Fitch applies a 0.75 multiple (i.e. 25% haircut) to the assumed recovery rate of the largest risk contributors. This stress is applied within the model framework to standard recovery assumptions or assets with RRs, and has an effect on the portfolio loss distribution. The stress is not applied to asset-specific recovery estimates, which are assigned to individual assets but it is applicable to assets with RRs.

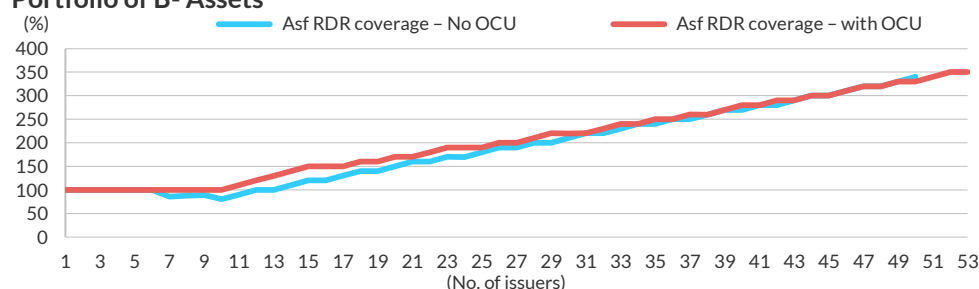
While the risk, with respect to recovery rates, is relatively apparent, the obligor coverage produced by the methodology is a function of the correlation assumptions and much less straightforward. Similar industry and geographic diversity portfolios with a larger number of obligors are expected to be subject to lower volatility in terms of default rates. The PCM model framework is already sensitive to obligor concentrations in that the rating default-rate increases as portfolios contain fewer assets.

Furthermore, the CDO target default probabilities are the same as, or lower than, the input default probabilities. Accordingly, the RDR for each liability rating level covers at least the largest obligor with a lower rating and a term equal to, or longer than, the WAL of the portfolio. This approach creates what can be thought of as a floor in the assumed default rate, such that there is protection in the event the larger assets default. This is particularly important where the portfolio credit quality is relatively high, and individual assets can represent a large proportion of the support available to a particular class of rated notes.

The joint coverage of several of the largest obligors is a function of the correlation assumption. In order to address the idiosyncratic risk with respect to the default behaviour of the largest obligors, Fitch applies a correlation stress of 50% to the largest risk contributors. The largest risk contributors are determined based on the notional size of individual issuers in the portfolio. The stresses are applied to the largest issuers up to a maximum of 15 for which the aggregate notional size is in excess of 30% or any individual issuer that is at least 6.5% of the portfolio notional size.

For example, for an equally weighted portfolio of 15 issuers the stress would be applied to all 15 issuers, as each is 6.7%. On the other hand, no stress would be applied if the largest 10 issuers represent 20% or less of the portfolio notional size, as the largest 15 would have to be 30% or less. The methodology seeks to address coverage of the largest risk contributors. For example, the chart below shows the 'Asf' RDR covers at least the largest 10 'B-' issuers.

Asf RDR Coverage of the Largest 10 Issuers for Equally Weighted Portfolio of B- Assets



RDR – Rating Default Rate. OCU – Obligor concentration uplift.
Source: Fitch Ratings

Excessive Obligor Concentration

The correlation and recovery stresses outlined above address the idiosyncratic risk, with regards to larger obligors, in reasonably diverse portfolios. It is theoretically possible to have a 'AAAsf' rating on a portfolio with only a few loans, albeit with very high credit enhancement. Even if the loans may be assumed to default, the methodology still assumes recovery proceeds at the 'AAAsf' stress level.

In Fitch's view, however, such excessive obligor concentration bears too much idiosyncratic risk, with regards to achievable recovery rates, and we would not assign high investment-grade ratings. For example, Fitch would not assign a new rating or upgrade an existing rating higher than 'BBBs' for a portfolio with fewer than 10 obligors, all rated 'B'.

Fitch analyses the potential for excessive obligor concentrations throughout the duration of the transaction, which may become more concentrated at the end of their lives as a result of unexpected default or pre-payment behaviour. We would apply the principles above but a committee may decide not to downgrade a rating if, for example, there are other mitigating factors such as short remaining life for the notes or performance history of the transaction.

Portfolio Management

Transactions may be static or managed. Fitch considers there may be additional risk in managed transactions, given that the portfolio may deteriorate not only by natural credit migration but also by substitution of assets during the revolving period. Available credit enhancement may be affected by realised gains or losses that result from trades, and from defaults and amortisation.

When analysing transactions that include portfolio covenants and eligibility criteria in their documentation, Fitch will consider all covenants and all aspects of the management guidelines, including asset eligibility criteria and the manager's ability to:

- Substitute assets freely or subject to defined covenants;
- Substitute impaired credits freely or not;
- Withdraw or monetise "surplus" credit enhancement; and
- Obtain quotes or trade with dealers other than the arranging bank.

Actively managed portfolios are initially rated based on a Fitch stressed portfolio created based on the terms and conditions in the transaction documents. We maintain our ratings on actively managed portfolios by monitoring the performance and credit profile of the actual portfolio relative to the initial stressed portfolio analysis. In instances where there is limited or no portfolio management, Fitch maintains ratings based on the analysis of the static portfolio of identified assets.

Fitch Stressed Portfolio

In its analysis of transactions with managed portfolios, Fitch analyses stressed-case portfolios with the aim of testing robustness of the transaction structure against its covenants and portfolio guidelines. Typically for US CLOs, we start with the initial indicative portfolio provided by the arranger and then make adjustments to account for certain concentration limitations. This is completed with the CLO-Fitch Stressed Portfolio Model. The indicative portfolio provides a good gauge of assets the portfolio manager is likely to purchase, at least for US CLOs with a broader universe of leveraged loans.

In the case of most European CLOs, Fitch uses a standardised stress portfolio that is customised to the specific portfolio limits for each transaction as specified in the transaction documents. European CLOs tend to have a high overlap in terms of issuers and loans, due to the limited universe of eligible assets. As a result, managers have significantly less choice in the portfolio selection for European CLOs compared with US CLOs backed by BSL or middle market loans.

The following are the most common adjustments applied to the indicative portfolio for typical CLOs. The same principals are also reflected in the standard stress portfolio in the case of European CLOs. This list is not exhaustive, as some CLOs may allow for limited exposure to certain asset types or other risk factors that Fitch may choose to stress in its analysis. The Fitch stressed portfolio will be determined in Fitch's committee process.

We will consider the expected ability of the manager to create a portfolio at the limit of its covenants. The absolute limit of some covenants may not be achievable in reality. An example would be the absence of a covenanted country concentration limit in a European CLO, where historically no portfolio had more than 35% exposure per country. In such cases, we will create a stressed-case portfolio with less than 100% single-country concentration, despite the lack of a country limit.

Obligor Size

A typical CLO will cap the size of obligors, with an allowance that a specified number may be a larger percent. We assume managed portfolios are generally managed toward permitted concentration limitations that can lead to increased portfolio concentration. This may lead to more volatile portfolio performance, resulting in higher default expectations under high investment-grade rating stresses.

With regard to obligor size, the stress portfolio is constructed to include obligors that match the maximum limits for the top five obligors. For instance, the indenture may specify each obligor to be 2.0% of the portfolio, with the exception that up to five obligors may each be up to 2.5%. In this instance, the Fitch stressed portfolio assumes these exceptions are maximised, with the top five obligors concentrated to represent 12.5% of the portfolio.

Portfolio Credit Quality

Fitch stresses credit quality of the portfolio by increasing exposure to assets in the 'CCC' category, or worse, based on the proportion permitted by the concentration limits, except for transactions that covenant to a Fitch weighted average rating factor (WARF), as defined below. For BSL CLOs, for example, the limit is set relatively low and Fitch would maximise the permitted amount or, if the indicative portfolio already exceeds the permitted 'CCC' allowance when mapping to our ratings, such proportion would be maintained.

Typically, limitations for assets rated in the 'CCC' category, or worse, are calculated based upon the then-current rating of assets. Where the definition of the limitation of 'CCC' category or lower-rated collateral varies from this, Fitch may apply additional stresses to the credit quality of the portfolio, which would be described in our rating report. If the transaction structure also includes a collateral quality test based on the Fitch WARF, then credit quality of the stressed portfolio is matched to the covenanted test level and exposure to 'CCC' category or lower-rated assets may not be assumed at the limit. This stressed assumption increases the portfolio default probability assumptions in PCM.

For US middle market CLOs, with a definition of Fitch Rating that permits non-rated assets (including credit opinions that expired 12 months after the initial assignment or most recent update) to be carried at a level above 'CCC', Fitch may apply additional stresses to the credit quality of the portfolio, which would be described in our rating report. Such stresses may also be applied and disclosed if transaction documents do not provide for issuer's ongoing notification to Fitch of material credit events, as specified in the Appendix 12.

Assets without a Fitch rating or Credit Opinion and without a public rating from another agency would be considered 'CCC', as explained in Appendix 5. However, for the purpose of calculating the WARF test, the manager may treat such assets as 'B-' if the Fitch derived rating based on private ratings provided by Moody's and/or S&P (for the avoidance of doubt, this means full ratings only and does not include Credit Opinions) is higher than 'CCC+'. While private ratings are available to managers they are not available to Fitch. Therefore, we would apply an additional stress if the exposure to such assets could exceed the typical limit of 10% of the portfolio notional amount. Fitch would expect that the use of this bucket is included in the regular transaction reporting.

Asset Security

A typical CLO allows for some portion of the portfolio to be invested in assets that are not senior secured loans, this could be second-lien loans or other instruments that have historically experienced low recoveries. Fitch's stressed portfolio analysis assumes the maximum allowance for non-first-lien collateral. For such assets our recovery assumptions would be zero in high investment-grade scenarios. Assets that are not senior secured loans are assumed to have weak recovery prospects. For portfolios of senior secured loans we assume the stress portfolio has similar seniority and recovery characteristics as the indicative portfolio provided and use RRs or recovery estimates where available.

If the transaction structure includes a collateral quality test based on the Fitch weighted average recovery rate (WARR), recovery assumption of the stressed portfolio is matched to the covenanted test level. The initial covenanted WARR is typically set below the weighted average recovery of the indicative portfolio, giving managers flexibility to buy assets with weaker recovery prospects.

Where a WARR is included, a homogenous portfolio distributed around the WARR is usually more conservative than a barbell portfolio including the maximum allowance of non-first-lien collateral. We would base the rating recovery rate (RRR) on the Interpolation Grid in Appendix 10, which is based on a typical portfolio without barbell seniority distribution.

Industry Concentration

CLOs typically have limitations on exposure to any one industry, with exceptions for a certain number of industries to exceed this limit. For instance, the indenture may specify each industry is limited to 10% of the portfolio, except three industries may be 12% and one may be 15%. The stressed portfolio is typically created maximising the permitted exposure to the three largest permitted industries. If industry limits are exceeded based on our view of the portfolio industry composition in the indicative portfolio, the stressed portfolio would maintain the same industry exposure for the outsized industries.

Risk Horizon

Managed CLOs have a defined reinvestment period that often extends the WAL of the CLO notes beyond the WAL of the initial indicative portfolio. The manager can usually reinvest between payment dates and continue to reinvest on a maintain or improve basis, even if portfolio profile tests in the transaction documents are not met. In Fitch's stressed portfolio analysis, the WAL of the assets is extended to match the WAL permitted by the terms of the CLO transaction documents to address the additional default risk inherent with a longer risk horizon.

Effective Risk Horizon

This stressed assumption increases the portfolio default probability assumptions in PCM. The stressed portfolio analysis WAL may be reduced by up to 12 months, in no case reducing the WAL of assets below six years or the WAL of the indicative portfolio, to account for structural and reinvestment conditions prevalent in a CLO post-reinvestment period. This ultimately reduces the maximum possible risk horizon of the portfolio when combined with loan prepayment expectations.

Minimum Risk Horizon

Fitch would apply a minimum WAL of four years in the stress portfolio for typical portfolios to account for increasing portfolio concentration and loan refinancing risk around their maturities. The analysis considers whether CLO ratings can sustain a higher default rate before assigning new ratings or upgrading existing ratings. Fitch may extend the legal final maturity of the CLO in line with the WAL extension to avoid creating long dated assets as a result of the WAL extension in its analytical modelling. This would also apply new ratings or upgrades linked to static portfolios, in addition to a one-notch downgrade on the Fitch IDR Equivalency Rating for assets with a Negative Outlook on the driving rating of the obligor, as described in the Static Portfolio Considerations section.

Cash Flow Stresses

Certain covenants and portfolio guidelines may allow for exposures that Fitch may stress in its cash flow analysis. For instance, if the transaction allows for some portion of the portfolio to be invested in fixed-rate assets, we will analyse the effect of this allowance being maximised. In a rising interest rate environment, fixed-rate assets could be a negative drag on interest proceeds available to notes. Fitch stresses the portfolio weighted average spread (WAS) and weighted average coupon (WAC) to the minimum level specified by collateral quality tests. These stressed assumptions limit the amount of credit applied for excess spread and influence BDR analysis (see Cash Flow Analysis).

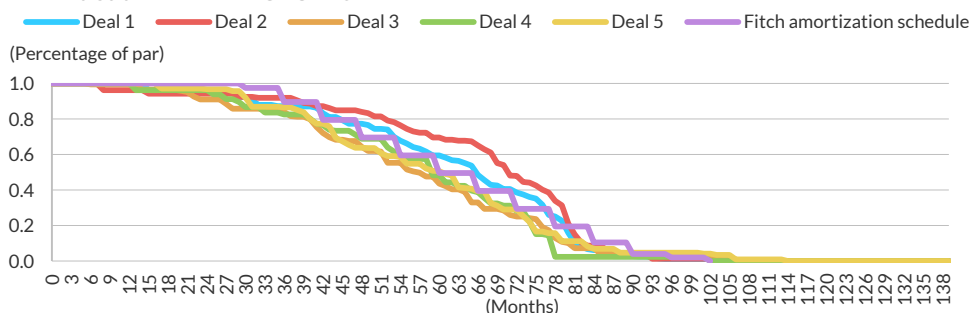
We analyse the potential risk of cash flow timing mismatches associated with allowances (exceeding 10%) for assets that pay less frequently than quarterly, in a quarterly pay transaction, if no structural mitigations are present, such as interest smoothing accounts or a frequency switch mechanism. The latter are standard in European CLOs. The potential is maximised for these types of exposures and assumes 75% of assets pay in quarters one and three and 25% of assets pay in quarters two and four.

Asset Repayment Assumptions

In modelling CLO note amortisation we generate an assumed principal payment schedule. We use the actual maturity profile of the identified portfolio assets as a proxy for the expected portfolio repayment profile as the CLO enters the note amortisation period. In the stress portfolio analysis, the WAL of the assets is extended to match the risk horizon of the CLO as specified in the *Risk Horizon* section above.

For European CLOs, Fitch uses a standardised amortisation profile together with a standardised stress portfolio. European CLOs tend to have a high overlap in terms of issuers and loans, due to the limited universe of eligible assets. As a result, managers have significantly less choice in terms of portfolio selection for European CLOs compared with US CLOs.

Amortisation Profile CLO 1.0



Source: Fitch Ratings

Portfolio Trading Limitations

Limitations on portfolio trading are expected in managed CLO structures. Typically, these triggers are based on collateral quality tests established at the onset of the transaction. If the performance of the actual portfolio significantly deteriorates, such that certain collateral quality tests fail, then the trading activity is expected to either maintain or improve the pre-trade test levels.

Fitch portfolio metrics normally include a Fitch WARF Test and a Fitch WARR Test. Typically, these two tests, along with the Minimum WAS Test, form the basis for dynamic portfolio management, via a Fitch Test Matrix. The calculations for a Fitch WARF and Fitch WARR are included in Appendix 6. Alternatively, trading metrics may also reference outputs from Fitch's PCM. Our analysis of notes issued by a CLO that incorporates PCM outputs into portfolio management limitations will be based upon analysis testing the robustness of the structure against such PCM outputs assuming a portfolio that corresponds to the PCM output limitations defined by the transaction documents.

To analyse the Fitch Test Matrix, Fitch creates a stress portfolio for one WARF in the matrix, which is then used to linearly extrapolate the default assumption for the other Matrix WARFs. A one-point increase in the WARF corresponds to an approximately 1% increase in RDR at all rating levels. This relationship between WARF and RDR holds for typical CLO portfolios with WARF in the range between 20 and 35. The WARF range may increase to 40 for transactions with a higher limitation for assets rated in the 'CCC' category or worse.

Fitch may create bespoke stress portfolios for each WARF outside of this range. Since test matrices often include several thousand different WARR points, we interpolate recovery rates for each rating level based on the WARR and asset-specific recovery assumptions, as shown in Appendices 4 and 10. We aim to analyse all different combinations of WARF, WAS and WARR in the matrix. However, arrangers may specify highly granular matrices with incremental increases in the WAS of less than 20bps. In these cases, Fitch will analyse a grid of rows with WAS increments of at least 20bps.

These tests are typical for Fitch-rated European CLOs and US middle market CLOs, as the analysis primarily relies on ratings and Credit Opinions provided by Fitch's corporate group. These tests may not be present in US BSL CLOs, where other collateral quality tests are present and another agency assigns ratings to issued and funded notes with subordinated priority to the Fitch analysed notes. In instances without specific Fitch tests, we will consider collateral quality tests included in transaction documentation when building a stressed portfolio. However, when assigning ratings to classes of notes subordinate to notes rated by other rating agencies, we will rely upon the Fitch specific collateral quality limits indicated in the transaction documents when creating the stressed portfolio.

Static Portfolio Considerations

New ratings for CLO notes backed by static portfolios are assigned based upon a scenario that assumes a one-notch downgrade on the Fitch IDR Equivalency Rating for assets with a Negative Outlook on the driving rating of the obligor. Rating reviews for notes issued by static CLOs and

CLOs no longer likely to reinvest apply these same assumptions when an upgrade of a note is considered. Rating reviews considering an affirmation or downgrade of a note from these types of CLOs do not assume the one-notch downgrade on the Fitch IDR Equivalency Rating for assets with a Negative Outlook. This analysis is generally not applicable for CLOs with a remaining reinvestment period as the Fitch stressed portfolio analysis is more constraining than results using this assumption. All MIRs are based upon the relevant portfolio described in this section.

Operational Risk Considerations

Operational risk considerations for a managed portfolio apply equally to substitution agents, portfolio advisors, liquidation agents and other parties that perform manager functions. Parties performing manager functions must establish they have sufficient experience, systems and procedures and can reasonably be expected to manage the CLO in compliance with the transaction documents to be viewed as acceptable.

Fitch will not rate transactions managed by parties that are not viewed as acceptable, unless there are other mitigants, such as a back-up manager. Fitch may consider a manager to be unacceptable if it believes the CLO covenants cannot be relied upon due to lack of experience by the manager or other operational concerns. The initial operational risk assessment review covers the manager's company, controls, investments, operations and technology, as described in *Appendix 9*.

Fitch will update its assessment of managers when assigning ratings to new transactions if any of the following are materially changed since its last assessment of such manager:

- Ownership structure;
- Key employee departure;
- Regulatory actions or criminal/civil actions levied against firm or employees; and
- External audit or regulatory exam findings.

Organisations may undergo multiple operational reviews or updates to assessments if they maintain multiple business lines that issue corporate CDOs, such as US BSL CLOs, US middle market CLOs and European CLOs, as each business line may have different operations, technology, etc. In the event a manager is being replaced in a transaction, Fitch needs to be notified of the proposed change and will review the successor manager. We may decide to withdraw or downgrade the ratings if the new parties are not viewed as acceptable to manage a Fitch-rated CDO or CLO.

Cash Flow Analysis

To determine the rating of a given tranche of notes, we analyse a series of stress scenarios to determine whether the payment of interest and principal according to the terms and conditions of such notes is fulfilled across all scenarios. In our rating reports, we discuss the indications given by cash flow model runs in the scenarios summarised in the table below, and the related rating considerations.

Fitch uses the Global CLO Cash Flow Model for cash flow analysis. While the cash flow model analysis is an important consideration in determining the final rating, ratings are ultimately assigned by a Fitch rating committee that also considers other quantitative and qualitative factors.

BDRs are an output of Fitch's cash flow model that show the maximum portfolio default rates a class of notes can withstand in stress scenarios without experiencing a loss. BDRs for a class are then compared with PCM RDRs (hurdle rates) at the corresponding rating stress. The 'Bsf' rating stress is used as the 'CCCSf' input to the cash flow model. The committee considers the BDR compared with the hurdle rate as the key quantitative factor for assigning a rating.

The table below shows the standard scenarios Fitch runs for a corporate CLO in the absence of FX risk. These would be run to determine the model implied rating. Committees may assign ratings different to the MIR, see Rating Determination above, if, among other reasons, one or more of these scenarios do not reflect the committees' near-term expectation.

Summary of Standard Scenarios

Default Distribution	Interest Rate Trend
Front-Loaded	Rising
	Stable
	Decreasing
Middle-Loaded	Rising
	Stable
	Decreasing
Back-Loaded	Rising
	Stable
	Decreasing

Source: Fitch Ratings

Fitch's approach to cash flow modelling is based around determining whether a class of notes pays according to its terms, under a series of defined interest rate and default timing stress scenarios for a given rating level. If a particular class of notes has received payment in full in a given stress scenario, it is deemed to have passed that stress scenario.

Based on the outputs of PCM and the defined stress scenarios, Fitch's cash flow analysis determines whether the CDO liabilities receive principal and interest in accordance with the terms of the transaction documents. Fitch analysis uses a proprietary Excel-based cash flow model, customised for rating-relevant structural features for each transaction, based on information and transaction documents provided to us by the issuer, originator, or third-party agents on their behalf. Our cash flow model is not publicly available.

Each transaction's customised cash flow model accounts for the CDO's capital structure and unique structural features, including but not limited to:

- The interest and principal priority of payments, including provisions for various fees and expenses based upon a 30-day month convention;
- Coverage tests (e.g. overcollateralisation tests, interest coverage tests, reinvestment overcollateralisation tests);
- Any interest rate or currency swaps or hedges; and
- Other relevant structural features.

Timing of Defaults

Fitch uses different default timing scenarios to assess the ability of the structure to withstand various clusters of defaults. Our default timing scenarios apply peak defaults over a two-year period, which is consistent with research on historical default patterns. We will test the structure for front-, middle- and back-loaded peak default scenarios. The total amount of defaults will always be the same for each default timing stress.

The timing of the default peak is adjusted according to the portfolio's WAL, see Appendix 7 for default timings for portfolios with a WAL from 0.5 years to 10 years and above. As an example, the default timings used for a portfolio with a WAL from 7.875 years, up to, but not including, 8.125 years is as set out in the table below.

Default Timing for Rounded^a WAL of Eight Years (% Share of RDR)

Year	Front	Mid	Back
1	33.5	7.0	—
2	22.5	7.25	10.0
3	8.0	8.0	12.5
4	8.0	22.5	12.5
5	8.0	33.5	12.5
6	8.0	7.5	12.5

Default Timing for Rounded^a WAL of Eight Years (% Share of RDR)

Year	Front	Mid	Back
7	8.0	7.25	20.0
8	4.0	7.0	20.0

^a Rounded to the nearest 0.25 years. RDR – Rating Default Rate. WAL – Weighted average life.
Source: Fitch Ratings

For portfolios where the default patterns described in this report are not applicable, e.g. because the portfolio has a very short tenor or has an accelerated amortisation profile after the revolving period, Fitch may adjust the applied default patterns to account for the specifics of the analysed portfolio. Likewise, for portfolios with assets of notably long tenor exceeding 12 years, such as trust-preferred securities, multiple default peaks or extended default cycles may be applied to address the characteristics of the assets and the possibility the portfolio will experience multiple credit cycles.

When conducting cash flow analysis, Fitch's cash flow model first projects the portfolio scheduled amortisation proceeds and any prepayments for each reporting period of the transaction life assuming no defaults and no voluntary terminations, when applicable. In each rating stress scenario, these scheduled amortisation proceeds and prepayments are then reduced by a scale factor equivalent to the overall percentage of loans that are not assumed to default or to be voluntarily terminated, when applicable.

This adjustment avoids running out of performing collateral due to amortisation and takes account of the defaults projected to occur in each rating stress, such that they are realised in a manner consistent with Fitch's published default timing curve. During and after the global financial crisis many loans were subject to maturity amendments whereby lenders voluntarily agreed to extend the maturity, while borrowers continued to make interest payments. The margin rate was often increased as part of the amendment. Fitch believes this modelling approach is consistent with the observed amend and extend activity during the heightened default environment.

Interest Rate Stresses

Fitch analyses rising, falling and flat interest rate scenarios in its cash flow analysis. Rising and falling scenarios are in accordance with Fitch's *Structured Finance and Covered Bonds Interest Rate Stresses Rating Criteria*.

Timing of Recoveries

Recoveries are assumed to be received following a lag period after default. Recoveries may come from either work-out or sale of the defaulted asset. For cash flow scenarios, Fitch assumes that recoveries are produced as a part of a work-out, in line with the manner in which its relevant corporate teams assign recovery assumptions.

We consider it more stressful to assume lags, in order to maximise negative carry, particularly given positions may be illiquid and price determination difficult. The timing of recoveries assumes no interest proceeds from defaulted assets over the time of the work-out period. This results in negative carry, as the liabilities have to be paid, while defaulted assets are assumed to generate no cash flow between default and recovery.

In cash flow analysis Fitch models an aggregated portfolio profile rather than individual assets. For US CLOs, the recovery lag is assumed to be 12 months. The recovery lag for European CLOs is 18 months for 'Asf' rating levels and higher, acknowledging less favourable workout regimes across European jurisdictions. For 'BBBs' and below, the recovery lag in European jurisdictions is 12 months. While EMEA CLOs can include US loans/bonds, these would typically not exceed 25% and we apply the same recovery lag for all assets in EMEA CLOs.

Additional Default Risk in Revolving Transactions

Managed transactions may also have the ability to reinvest recovery proceeds from defaulted assets, or from interest proceeds diverted via failure of an interest diversion test or other similar reinvestment over collateralisation test. These new assets are subject to default risk that is not

Fitch's *Structured Finance and Covered Bonds Interest Rate Stresses Rating Criteria* include stresses to address the risk of negative interest rates in structured finance transactions. CLOs are unlikely to be affected by negative interest rates. Therefore, we apply the standard (positive) interest rate downward stresses in our CLO rating analysis.

reflected in the expected default rates derived by PCM. Instead, Fitch takes into account this additional default risk in its cash flow modelling approach.

We assume proceeds reinvested during the reinvestment period are used to purchase assets with the same risk profile as the outstanding performing portfolio at the time of the reinvestment. Collateral quality tests in transaction documentation typically incorporate a limited buffer relative to quality metrics of the actual portfolio. This is achieved by modelling reinvestment as an increase in the current portfolio size. To capture the default risk on these newly acquired assets, the periodic default rate applied on the outstanding performing portfolio is also applied to these assets, given they share the same credit characteristics. An example of the methodology is provided in *Appendix 8*.

Available Cash Investments

Fitch assumes cash balances held in a transaction's interest and principal collection accounts between payment dates will earn interest at a spread of 50bps below the relevant reference index, e.g. Euribor/SOFR/Libor, floored at zero. We will adjust these assumptions if the contractual rates are less favourable to the issuer than the above assumption.

Senior Fees and Asset Spreads

For corporate CDOs, the cash flow modelling is based on contractual management fees, which reflect market rates. Fitch may stress the senior fees on a case-by-case basis, if the contractual rates are deemed to be below the market rate. The basis for the fees may vary between transactions. Most commonly the senior fees are calculated based on the balance at the beginning of the period including defaulted assets at par.

Fitch tested the effect of different definitions, such as the average balance or excluding default assets, and found it has no material effect on the BDRs. Therefore, we will model the most common fee basis definition for all transactions. Asset spreads are based on the actual spread for static transactions and the covenanted minimum spread level for replenishing transactions.

Call Options

Historically, most CLO notes are repaid through the exercise of the call option, which typically is controlled by the CLO equity investors. Fitch's analysis assumes that the call option is not exercised and the CLO notes are repaid through asset repayments. Our ratings are therefore de-linked from the creditworthiness of the call option holder. We expect CLO indentures to specify that principal and accrued interest on all notes is paid in full as a condition to exercise the call option.

Long-Dated Assets

CLO structures that allow managers to invest in loans with maturity dates after the legal maturity of the bonds or perpetual bonds may expose the notes to the market value of those assets. Fitch expects limitations to be in place to restrict the ability of the manager to invest in such long-dated assets.

If the CLO structure allows the manager to acquire assets (either by way of outright purchase or exchange) with a tenor after the final note payment, we will assume such assets are subject to a fire sale prior to or at the last payment period and the CLO notes only receive the assumed recovery value.

In certain instances, the CLO structure may receive long-dated assets via maturity extensions or other types of distressed debt management techniques. Fitch views the overcollateralisation test haircuts applied to long-dated assets as a disincentive to use such provisions opportunistically. In the absence of a sufficient overcollateralisation test haircut, the Fitch stressed portfolio analysis would utilize the approach outlined above related to outright acquisitions.

For surveillance analysis, Fitch applies the same stress as the one described above for the outright purchases, for long dated assets held in the portfolio.

Some CLOs allow for the limited reinvestment of unscheduled principal proceeds and proceeds from the sales of credit risk and/or credit improved assets after the reinvestment period. In this case, Fitch expects the CLO transaction documents to contain sufficient provisions to limit the amount of the investment portfolio that may be outstanding as the transaction reaches maturity. Typically, this is accomplished by reducing the WAL test value down to zero by the end of the note amortisation period.

Over Collateralisation and Interest Coverage Tests

Fitch evaluates the prescribed calculations of a transaction's over collateralisation and interest coverage tests to determine whether such tests will effectively divert cash proceeds to the senior notes upon negative rating migration and/or defaults in the portfolio. The over collateralisation tests for most high-yield CLO transactions, for example, include multiple haircuts when calculating the par amount of collateral available to support the rated notes.

If Fitch believes such tests are calculated in a manner that renders them relatively ineffective, additional sensitivity scenarios or adjustments to Fitch's rating stress scenario may be warranted. Adjustments for inefficient over collateralisation measurements may include not modelling the over collateralisation tests during the reinvestment period, thereby not giving credit for excess spread while the asset manager can purchase additional assets.

CLO structures normally provide that assets rated in the 'CCC' rating category or lower, above a certain threshold (typically 7.5%), are carried at an adjusted value. This may mean over collateralisation tests become effective earlier than if they were to rely on defaulted assets alone. In lower rating stresses, categories 'Bsf' and 'BBsf', Fitch would expect obligors that ultimately default to first be rated 'CCC', causing over collateralisation tests to fail earlier.

In particular, Fitch assumes the proportion of 'CCC' assets in the portfolio to be a multiple of the projected default rate for the 12-month period ahead. We assume an average 12-month default rate for 'CCC' rated borrowers of 25%, which is consistent with empirical observations. This assumption implies a multiple of 'CCC' obligations to defaulted obligations of four times. For the 'BBsf' category scenarios, Fitch applies a multiple of 2.5x, and for the 'Bsf'/'CCCsf' category scenarios the applied multiple is 3.5x. These multiples are set below the historical 4.0x average to account for the potential for higher-rated obligors jumping to default but without migrating to 'CCC' first. In both scenarios, the proportion of 'CCC' assets of the performing portfolio is capped at 50%.

The adjusted value for excess 'CCC' obligations in CLOs is typically the lower of par and their market value. Fitch does not model the market value explicitly but assumes that in lower rating stresses the recovery assumption is a good indicator for the market value. For example, assuming an RDR of 30%, the front-loaded default timing for a WAL of eight years allocates 8% of the RDR to year three. This corresponds to an assumed 2.4% of the initial target par amount of the portfolio ($30\% \times 8\%$) expected to default during year three. For a 'Bsf' scenario, Fitch assumes 8.4% ($3.5x \text{ 'Bsf'} \times 2.4\%$) of the portfolio to be rated 'CCC' or worse during the second year of the transaction life and for a 'BBsf' scenario 6.0% ($2.5x \text{ 'BBsf'} \times 2.4\%$).

Defaulted assets are typically included at the lower of the market value or a predetermined recovery rate, defined in the transaction documents. Fitch believes these haircuts can serve as early indicators of deteriorating collateral performance and are important for preserving a minimum ratio of underlying collateral value available to the senior notes.

Multi-Currency Structures

Most European CLOs use perfect asset swaps to hedge FX risk for non-Euro-denominated assets. Some structures can have limited exposure to UK pound and US dollar assets not covered by perfect asset swaps. The maximum currency bucket has been 10% to date, against 5% of liabilities, leaving a 5% of reinvestment target par mismatch between assets and liabilities (residual exposure).

The approach outlined here only applies to transactions where residual exposure, mismatch between assets and liabilities, does not exceed 10% of the transaction target par amount at closing. Market risk in the form of FX exposure should not be the primary rating driver in CLO structures. The approach outlined below will be applicable where the size of the FX bucket is limited and/or the effect on the rating, when compared with an all-Euro structure with similar characteristics is limited. Such an asset/liability hedging strategy is not perfect and exposes the structure to residual currency risk.

For example, defaults may reduce assets and as a result the FX liabilities have to be repaid by converting Euro proceeds at spot. Similarly, FX liabilities that rank pro rata with the corresponding euro tranche are less effective than, for example, variable funding notes. Unless

the issuer receives the correct proportion of FX proceeds and Euro proceeds, it will have to convert one or the other at spot in order to maintain the pro rata split of the liability structure.

If for example the UK pound sub-portfolio has a significantly longer WAL than the Euro sub-portfolio, the effectiveness of the liability hedging could be significantly reduced, as the UK pound tranches would be repaid from Euro proceeds prior to receiving the UK pound proceeds, leaving the structure unhedged. To mitigate this risk, European CLOs include specific WAL tests for each sub-portfolio. To test the effectiveness of an imperfect asset/liability hedging, Fitch will test the structure by modelling stressed FX rates for each currency under the standard interest rate and default timing scenarios.

The FX stresses and the currency pair categorisation are published in an Excel file entitled *Fitch's Foreign-Currency Stress Assumptions for Residual Foreign-Exchange Exposures in Covered Bonds and Structured Finance*. Both the definition of the stresses and the assignment of currency pairs to categories will be reviewed on a regular basis. A detailed description on Fitch's methodology for deriving these currency stresses is provided in *Covered Bonds Rating Criteria*. These stresses are applicable to transactions with a typical WAL of up to eight years. Fitch will typically limit the interest rate differential for FX structures. This applies to scenarios where one index is stressed up, while the other is modelled down or flat. For example, in the case of UK pound/euro, Fitch would cap the difference between UK pound Libor and Euribor at 6%.

If defaults were to occur unevenly across such a portfolio, the effect of FX rates and interest rates on unhedged risks can be magnified in the structure. Therefore, for CDOs with FX exposure, Fitch will also analyse the impact of defaults skewed toward each sub-pool within its cash flow modelling framework. The following default skew stresses would be used for a multicurrency transaction, or transactions with significant fixed/floating interest rate mismatches.

Default Skew Stresses for Foreign-Exchange Mismatches

Rating Scenario	Pool One	Pool Two
AAA	62.5	37.5
AA	60.0	40.0
A	57.5	42.5
BBB	55.0	45.0
BB	52.5	47.5
B	50.0	50.0

Note: A 60%/40% default skew would imply that 60% of defaults would occur in Pool One if the pools were of equal weight. Please contact Fitch to obtain the default skew percentages for non-equally weighted portfolios.
Source Fitch Ratings

For very small FX exposures, which could include only a few assets, the committee may also consider a more significant skew proportion in assigning the rating.

Combination Notes

Combination notes are notes where tranches from CLOs or corporate CDOs are combined, in whole or in part, to form new securities. Combination notes may include other securities, such as government bonds. The cash flow modelling methodology outlined in this report is applied to determine the effect of the various scenarios described above on the principal and interest cash flows described in the terms and conditions of the combination note. Typically, the combination noteholders are entitled to all distributions of principal and interest on the underlying components. Combination notes may take many forms and each proposal needs to be evaluated on its specific merits.

The Factors used by Fitch when Deciding if the Combination Note is Rateable Include the Following:

- Availability of sufficient information to analyse each of the underlying components; and
- The terms and conditions of the combination notes match the anticipated payment profile of the included notes.

The most common form of combination notes transforms bonds paying both principal and interest into principal-only notes. Credit enhancement is created by converting interest

Fitch will not rate new combination note structures on the basis of a "rated balance" that may differ from the "stated balance" of the notes over time as there is an elevated risk that the rating may be misconstrued or misunderstood by those relying on the rating like investors, risk managers or regulators.

Other structural considerations for combination noteholders include:

- Voting rights for supplemental indentures that may alter cash flows,
- Reporting and notifications to investors and rating agencies on distributions and outstanding balances.

payments on highly rated notes to cover principal on lower-rated or unrated notes. The included components generate sufficient cash flows to satisfy repayment of the combination notes under the specified rating stress scenarios including use of the Fitch stressed portfolio and the indicative portfolio. If a potential principal shortfall exists in our cash flow analysis associated with a specific rating level, then that rating level can be assigned to the combination notes only in the presence of some form of additional credit enhancement that mitigates the shortfall.

Often, this additional credit enhancement will be one or more principal-only securities that are included to provide principal cash flows toward the end of the transaction. This would be available to offset potential shortfalls that occur in a stress scenario. In these instances, the combination notes' ratings are determined through the application of the Two-Risk Credit-Linked Notes Matrix in the *Single- and Multi-Name Credit-Linked Notes Rating Criteria*, where the principal-only issuer and the combination notes are the risk-presenting entities.

We assume an additional administrative expense at the bottom of the CLO waterfall when calculating the cash flows available to CLO equity components of a combination note. The same analytical framework applied in the combination note analysis is used when analysing structures backed by notes of more than one CLO. Each distinct CLO portfolio and structure will be analysed separately using the same rating level stress levels. Then cash flows from each component of the combination note are aggregated for each of the nine interest rate and default timing scenario combinations.

The most conservative of the nine cash flow scenarios must be sufficient to repay the combination notes in accordance with their terms under the rating stress. For example, cash flows from the 'Asf' rating stress analysed in a rising interest rate and front default timing scenario would be determined from each CLO component note. The resulting cash flows from all component notes, and other potential sources, such as pledged management fees, that secure the combination note would be applied to the combination note structure to test if cash flows are sufficient to support an 'Asf' rating.

Early redemptions, re-pricing or other features, such as allowances for additional indebtedness affecting the underlying component notes, may lower cash flows to the combination note beyond those assumed in Fitch's analysis of the indicative portfolio or Fitch stressed portfolio. To the extent these early redemption or re-pricing features exist in the underlying CLO, Fitch expects additional structural features to specifically address any potential adverse effect on the combination notes. The features may include: automatically exchanging the combination note back to its component notes; the combination notes being paid in full; allowing for 100% combination noteholder consent; or relying on confirmation that no rating changes would be expected in order to mitigate the risk of redemptions, re-pricing, or other features adversely affecting the combination notes.

The combination note structure should clearly define what happens to the underlying component notes after all the payments are paid or if the combination note is terminated early. The two most common structures involve either automatically exchanging the combination notes back into the underlying component notes or creating a structure with a residual class of notes. In exchangeable note structures Fitch will withdraw the rating on the combination notes after they are exchanged or mark them Paid in Full if the balance is reduced to zero. In residual class structures, once sufficient proceeds are received, or set aside as cash or highly-rated and liquid securities, to repay the nominal balance of the combination note, we will mark the combination notes ratings Paid in Full.

Counterparty Considerations

It is Fitch's understanding that any payments made by the borrowers or lenders under a syndicated loan structure, would typically be transferred by the agent within one business day to the borrower or issuer account. We, therefore, deem commingling and counterparty risk with regards to syndications agents as immaterial.

Excessive counterparty risk is typically not a concern in CLO structures, as the assets are sourced in the open market from different counterparties. Managers are also incentivised by the structure to avoid large cash holdings and many actually run negative trade date cash balances. The initial ramp period following closing is only six months. Finally, EMEA CLOs use

derivative counterparties to hedge FX and interest rate risk through perfect asset swaps. The counterparty exposure is typically small and often spread across different counterparties.

Transaction-Specific Disclosure

In its Initial Rating Report or Initial Rating Action Commentary Fitch Expects to Disclose the Following:

- Any variation to the rating mapping approach outlined in this report, for example if the mapping approach is applied to portfolios that fall outside the listed criteria;
- Correlation framework for EM portfolios, if different from the one outlined in this report;
- Any adjustments to the recovery rate assumptions;
- Any adjustment to asset default assumptions due to adverse selection, as indicated by an over proportional share of Negative Outlooks;
- Any specific stresses applied to the Fitch stressed portfolio for risk factors other than those outlined in this report; examples include 'CCC' limits and long-dated assets;
- If and why a committee assigned a rating different to the model implied rating;
- Adjustments for inefficient over collateralisation tests;
- Adjustments to the applied default patterns; and
- Comparison analysis of mid-cap portfolio financial ratios with the ones reported in Fitch's Leveraged Loan Chart Book for borrowers in the same jurisdiction.

In its Surveillance Rating Action Commentary Related to an Upgrade or Downgrade Fitch Would Expect to Disclose the Following:

- If and why a committee assigned a rating different to the model implied rating;
- Any adjustment to asset default assumptions due to adverse selection, as indicated by an over proportional share of Negative Outlooks;
- Any mitigating factors to concentration risk, for example short remaining life for the notes, or performance history of the transaction, if a committee decided not to downgrade a transaction with excessive obligor concentration.

Variations from Criteria

Fitch's criteria are designed to be used in conjunction with experienced analytical judgment exercised through a committee process. The combination of transparent criteria, analytical judgment applied on a transaction-by-transaction or issuer-by-issuer basis, and full disclosure via rating commentary strengthens Fitch's rating process, while assisting market participants in understanding the analysis behind our ratings.

A rating committee may adjust the application of these criteria to reflect the risks of a specific transaction or entity. Such adjustments are called variations. All variations will be disclosed in the respective rating action commentaries, including their effect on the rating where appropriate. A variation can be approved by a ratings committee where the risk, feature, or other factor relevant to the assignment of a rating and the methodology applied to it are both included within the scope of the criteria but where the analysis described in the criteria requires modification to address factors specific to the particular transaction or entity.

Limitations

Ratings, including Rating Watches and Outlooks, assigned by Fitch are subject to the limitations specified in Fitch's [Ratings Definitions](#). In addition, ratings within the scope of these criteria are subject to the following specific limitations:

- The criteria report does not cover any market value risk associated with corporate bonds or loans.

Rating Assumption Sensitivity

Fitch will run a range of sensitivity analyses on key input parameters to examine the rating stability of each rated note. The objective of this stress testing is not to eliminate rating migration through unrealistically conservative assumptions but rather to test that a small change in input parameters does not result in a multi-category downgrade.

The sensitivity analysis results will be published in our presale and new issue reports for each rated transaction and is performed for initial ratings or material restructurings. For surveillance reviews the initial sensitivity analysis is typically still applicable and we will refer to results of initial sensitivity analysis.

Fitch will Review the Effect on the Rating for the Following Sensitivities:

- Rating sensitivity to default probability:** multiplier of 125% and 150% applied to mean RDR, with increase in the mean RDR added to all other rating level RDRs.
- Rating sensitivity to recovery rates:** multiplier of 75% and 50%, i.e. 25% and 50% haircuts, respectively, applied to the RRR for all rating levels.
- Combined stress:** default probability multiplier of 125% applied to mean RDR, with increase in the mean RDR added to all other rating-level RDRs, and recovery rate multiplier of 75%.
- Combined stress:** default probability multiplier of 150% applied to mean RDR, with increase in the mean RDR added to all other rating-level RDRs, and recovery rate multiplier of 50%.
- Upgrade combined sensitivity:** default probability multiplier of 75% applied to mean RDR, with the change in mean RDR subtracted from all other rating-level RDRs, and recovery rate multiplier of 125%.

The tables below show the sensitivity results for two example portfolios. The analysis is only based on the asset performance, excluding structural features and cash flow modelling.

Portfolio One: Leveraged Loan CLO

Initial Rating	Base RLR (%)	Indicative Rating						
		RDR + 25% x mean	RDR + 50% x mean	75% x RRR	50% x RRR	RDR + 25% x mean; 75% x RRR;	RDR + 50% x mean; 50% x RRR	RDR -25% x mean; 125% x RRR
AAAsf	40.1	AA+sf	AAsf	AAsf	A+sf	A+sf	BBB+sf	AAAsf
AAsf	34.7	A+sf	A+sf	A+sf	BBB+sf	Asf	BBB-sf	AAAsf
Asf	26.3	BBB+sf	BBB+sf	BBB+sf	BB+sf	BBB-sf	BB-sf	A+sf
BBBsf	18.8	BB+sf	BB+sf	BB+sf	B+sf	BB-sf		A-sf
BBsf	12.6	B+sf	B+sf	B-sf				BBB+sf
Bsf	8.8							BB+sf

RLR – Rating Loss Rate. RDR – Rating Default Rating. RRR – Rating Recovery Rating. Note: Geographic location largest countries: France (30.7%), Germany (16.0%). 98 borrowers. Asset quality B- (34.8%), B+ (8.6%), B (48.8%), CCC (2.3%), balance in BB category. 90% senior secured loans. Portfolio WAL – 62 months. Largest industry 14.3%.
Source: Fitch Ratings

Portfolio Two: Investment Grade CDO

Initial Rating	Base RLR (%)	Indicative Rating						
		RDR + 25% x mean	RDR + 50% x mean	75% x RRR	50% x RRR	RDR + 25% x mean; 75% x RRR;	RDR + 50% x mean; 50% x RRR;	RDR -25% x mean; 125% x RRR
AAAsf	11.7	AA+sf	AA+sf	AA+sf	AA+sf	AA+sf	AAsf	AAAsf
AAsf	9.6	AA-sf	AA-sf	AA-sf	AA-sf	AA-sf	A+sf	AAsf
Asf	6.9	A-sf	A-sf	A-sf	A-sf	A+sf	BBB+sf	Asf

Portfolio Two: Investment Grade CDO

Initial Rating	Base RLR (%)	Indicative Rating						
		RDR + 25% x mean	RDR + 50% x mean	75% x RRR	50% x RRR	RDR + 25% x mean; 75% x RRR;	RDR + 50% x mean; 50% x RRR;	RDR -25% x mean ; 125% x RRR
BBBsf	4.5	BBB-sf	BBB-sf	BBB-sf	BB+sf	BB+sf	BB+sf	BBB+sf
BBsf	2.4	BB-sf	BB-sf	BB-sf	B+sf	B+sf	B-sf	BB+sf
Bsf	1.5	B-sf	B-sf	B-sf				BB-sf

RLR – Rating Loss Rate. RDR – Rating Default Rating. RRR – Rating Recovery Rating. CDO – Collateralised debt obligation. Geographic location: US 300 equally weighted assets. BBB rated assets. 100% senior unsecured loans. Five-year bullet loans. Diversified industry exposure.

Source: Fitch Ratings

Portfolio Performance and Surveillance

Outstanding ratings are reviewed at least annually. Transactions may be taken to credit committee more frequently, as warranted by performance or structural changes due to amendment activity, to maintain timely ratings on all Fitch-rated CDOs.

Appendix 1: Asset Default Rates

Cumulative Asset Default Rates

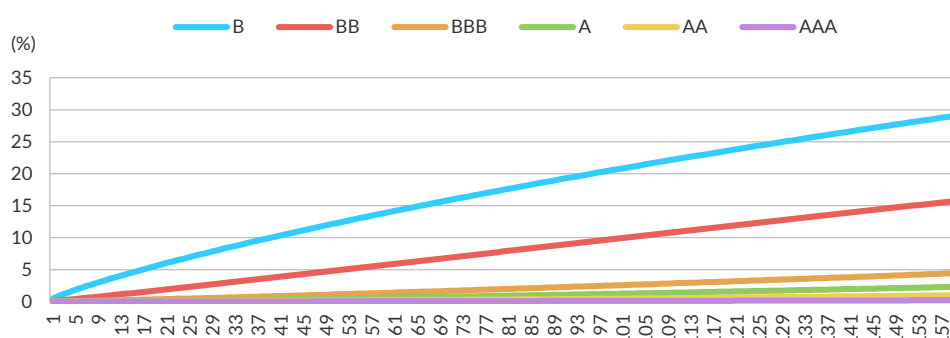
(%)	Term (Years)									
Fitch IDR	1	2	3	4	5	6	7	8	9	10
AAA	0.010	0.015	0.026	0.039	0.053	0.068	0.084	0.100	0.118	0.136
AA+	0.011	0.032	0.058	0.089	0.125	0.163	0.205	0.250	0.298	0.349
AA	0.016	0.048	0.092	0.145	0.208	0.278	0.356	0.441	0.532	0.629
AA-	0.020	0.063	0.122	0.194	0.279	0.375	0.481	0.598	0.723	0.858
A+	0.039	0.111	0.204	0.314	0.439	0.576	0.726	0.886	1.057	1.237
A	0.070	0.178	0.309	0.456	0.617	0.789	0.972	1.164	1.364	1.572
A-	0.116	0.278	0.463	0.665	0.880	1.107	1.343	1.588	1.840	2.099
BBB+	0.157	0.368	0.605	0.861	1.131	1.413	1.705	2.006	2.315	2.630
BBB	0.199	0.459	0.748	1.057	1.382	1.719	2.067	2.424	2.789	3.162
BBB-	0.513	1.084	1.677	2.283	2.898	3.519	4.145	4.774	5.406	6.039
BB+	0.862	1.755	2.655	3.556	4.457	5.354	6.249	7.138	8.023	8.903
BB	1.050	2.202	3.388	4.590	5.800	7.013	8.227	9.437	10.644	11.844
BB-	1.842	3.563	5.221	6.832	8.401	9.932	11.429	12.894	14.328	15.733
B+	2.664	4.940	7.060	9.069	10.991	12.837	14.618	16.340	18.008	19.627
B	3.807	6.723	9.330	11.734	13.983	16.108	18.127	20.054	21.899	23.671
B-	7.539	11.923	15.492	18.585	21.348	23.861	26.174	28.323	30.332	32.221
CCC+	11.227	17.023	21.548	25.354	28.674	31.633	34.311	36.759	39.016	41.111
CCC	14.833	22.071	27.576	32.112	36.000	39.413	42.457	45.204	47.705	50.000
CCC-	25.681	34.857	41.220	46.147	50.174	53.574	56.511	59.088	61.377	63.431
CC	50.500	56.500	62.500	68.500	74.500	80.500	86.500	92.500	98.500	100.00
C	75.500	81.500	87.500	93.500	99.500	100.00	100.00	100.00	100.00	100.00
D	100	100	100	100	100	100	100	100	100	100

IDR – Issuer Default Ratings. Note: The full 30-year table of default probability assumptions is available in the PCM.
Source: Fitch Ratings

The Weibull distribution was used to create a monthly term structure of default probabilities for 30 years, for each notched rating level. The Weibull distribution is often used in modelling survival rates and incorporates the exponential distribution but is more flexible in that it does not rely on constant hazard rates.

The distribution has a shape and scale parameter, which are estimated by numerically fitting the cumulative distribution to the cumulative target default rates for the one-, five- and 10-year horizons. The chart below graphically illustrates how the same distribution with different parameterisation can provide term structures for rating levels from 'AAA' to 'CCC-'.

Weibull Distribution: Probability of Default Term Structure



Source: Fitch Ratings.

Appendix 2: The Portfolio Credit Model

The PCM is used for analysing the joint default behaviour within credit portfolios. The model is based on the Gaussian copula function, which is based on the multivariate normal distribution Φ_{Σ} with pair-wise correlation matrix Σ . An important benefit of the Gaussian copula is its analytical tractability. The dependence structure is fully described by the pair-wise linear correlation assumption. For example, zero correlation in the Gaussian copula means all the default events are independent.

The key inputs to the model are default probabilities, correlation and recovery rates. The key output of the model is the default or loss distribution for a given credit portfolio. A correlation structure can be implemented in factor form.

For example, the one factor representation of the Gaussian copula is given by the following equation:

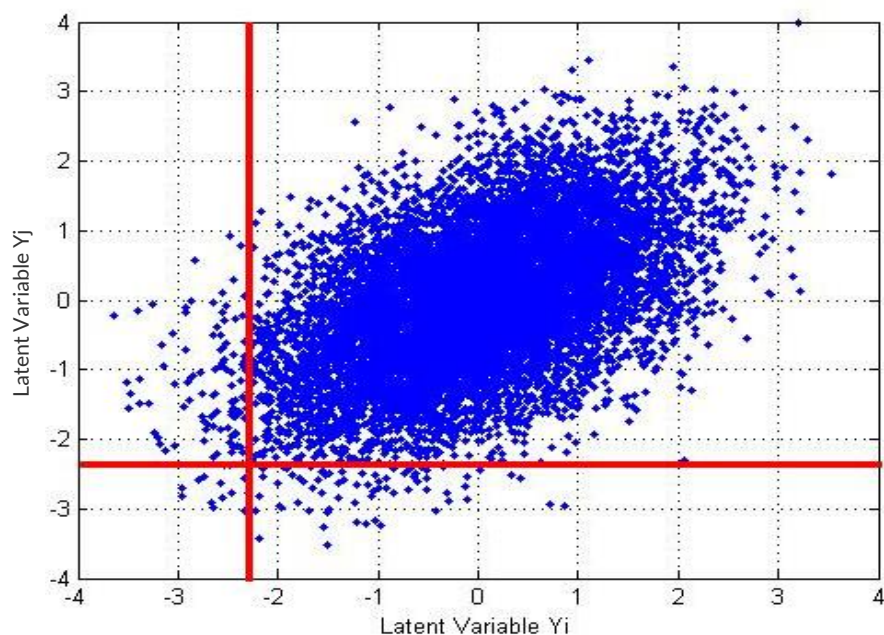
$$Y_i = \beta X + \sqrt{1 - \beta^2} \varepsilon_i$$

Here Y_i is a latent variable associated with credit i in the portfolio.

The Gaussian copula is often interpreted as a structural form model, which was pioneered by Merton. This model holds that a company defaults if the value of its assets falls below the value of its liabilities at debt maturity. Depending on the assumption with respect to the asset value process, it can be proven that the structural form model and the Gaussian copula are equivalent,

if the default occurs at maturity. The latent variable Y_i can therefore be interpreted as the standardised asset value for company i.

A default occurs if the latent variable Y_i falls below a threshold K_i . In the Gaussian copula the factor X and the idiosyncratic risk ε_i are standard normal random variables with zero mean and a standard deviation of one. The specific functional form of the factor model Y_i is also a standard normal variable with a mean of zero and standard deviation of one. Therefore, to match the default probability p_i the threshold K_i is computed as the inverse of the cumulative random normal distribution of the default probability, ie $K_i = \Phi^{-1}(p_i)$. Company i defaults if, $Y_i < \Phi^{-1}(p_i) \Leftrightarrow \Phi(Y_i) < p_i$.



Source: Fitch Ratings

Dependence is introduced by correlating the Y variables through the common factor X.

The pair-wise correlation between Y_i and Y_j is given by β^2 .

The one-factor model can be extended to a multi-factor model, which allows a more asset-specific correlation structure. The PCM incorporates a multi-factor correlation model which will be described in more detail in Appendix 3. For a portfolio of just two credits (bi-variate case) the Gaussian copula function can be illustrated graphically, as shown in Figure 18.

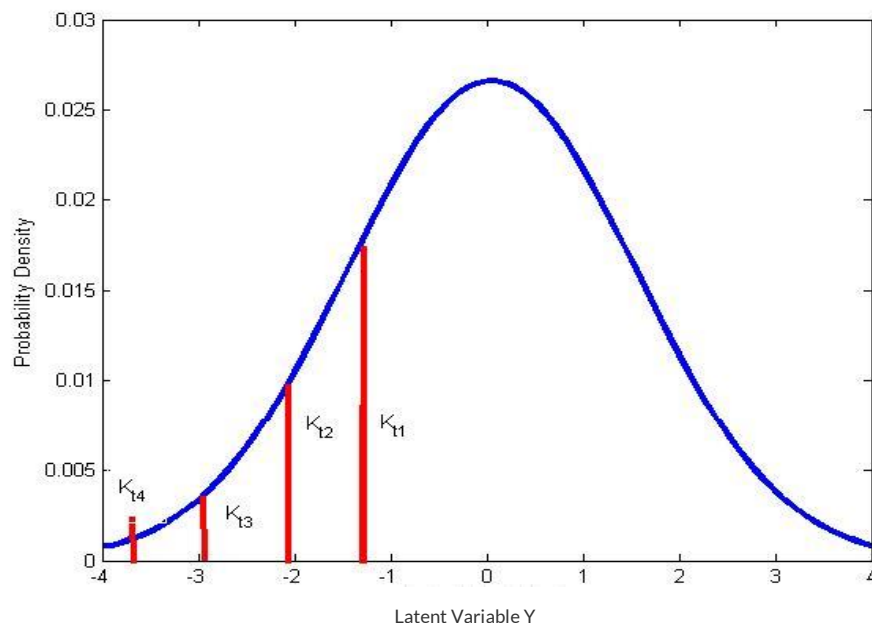
The scatter plot shows the joint distribution of the two latent variables (asset values) Y_i and Y_j . The red lines illustrate their respective default thresholds. The bottom left hand corner of the scatter plot shows the occurrences when both credits default.

So far, this paper has focused on a model with a specified fixed maturity T. The model can also be used to infer the joint time to default for all the credits in the portfolio. Given a term-

structure of default probabilities F_i for a specific credit in the portfolio, the time to default τ_i is given by

$$\tau_i = F^{-1}(\Phi(Y_i))$$

In other words, rather than specifying just one threshold K to determine whether an asset defaults at time T, the latent variable Y is compared to a specific threshold for each point in time.

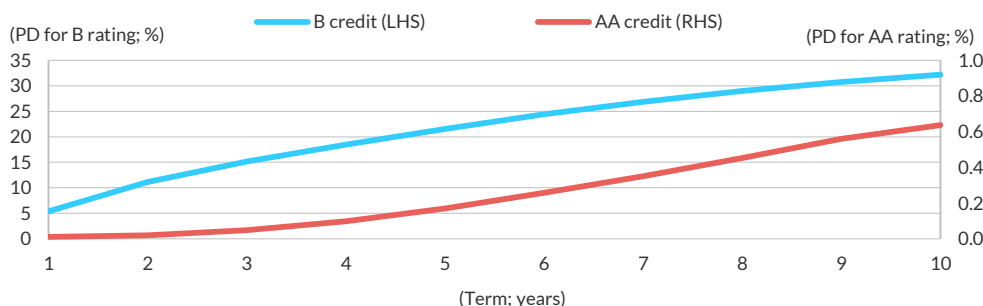


Source: Fitch Ratings.

In the PCM, the default probability term structures are derived from historical default rates rather than implied by spread or price levels. The chart below shows the term structure of default probabilities for a 'AA' and a 'B' rated asset.

The portfolio loss distribution for a fixed time horizon T can be generated using the Monte Carlo Simulation as follows¹.

Term Structure of Default Probabilities



Source: Fitch Ratings

1. Calculate the thresholds $K_i = \Phi^{-1}(p_i)$ for each credit. Here p_i is the default probability for name i that corresponds to the time horizon T.
2. Simulate a vector of independent standard normally distributed random variables \mathcal{E}_i (one for each credit in the portfolio).
3. Simulate a scalar standard normally distributed random variable for the factor value X.

¹The loss distribution of the one factor Gaussian copula can be derived much faster by semi-analytic techniques such as recursion or fast Fourier transform methods. The model also has a closed-form large homogeneous portfolio approximation. Nevertheless, all of these can only be used in a single-factor framework. For multi-factor extension, which the PCM is based on, Monte Carlo Simulation is the most efficient numerical scheme.

4. Compute $Y_i = \beta X + \sqrt{1 - \beta^2} \varepsilon_i$; for equal pair-wise correlation ρ between all credits $\beta = \sqrt{\rho}$.
5. The default time $\tau_i \leq T$, if the latent variable $Y_i \leq K_i(T)$.
6. Compute the portfolio loss as the sum up the loss given default of all credits (LGD) that defaulted prior to T. The PCM uses deterministic recovery rates.
7. Repeat steps 2 to 6 several thousand times. Compute the loss distribution as the histogram of portfolio losses over all simulation scenarios. The histogram is an approximation of the exact loss distribution and the numerical accuracy improves the larger the number of simulations.

CDO portfolios often include assets with different maturity dates or even amortising assets. The loss given default for a specific issuer in the CDO portfolio is derived from the outstanding notional of all assets in the portfolio at the time of default. Therefore, the simulation time horizon is effectively equal to the maturity of the longest asset in the portfolio.

Appendix 3: Correlation Calibration

Given the choice of model (Gaussian copula) and the corporate and CDO default rates, the only remaining parameter that would affect the default distribution produced by the model is the correlation. Generally, Fitch expects that the RDR for higher rating levels of 'Asf' and above should cover at least the historical peak default rate.

In order to calibrate the correlation assumption, we used large homogenous, randomly selected portfolios that resembled the cohort portfolios underlying the historical default studies. The objective was to find a single pair-wise correlation parameter, such that the RDR produced by PCM reflected the expected coverage of the historically observed peak. The table shows the RDR at each rating category for portfolios with different underlying credit qualities and tenors.

These were Generated using the PCM with the Following Assumptions:

- Historical corporate default rates;
- CDO default rates equal to historical corporate default rates;
- Gaussian copula model; and
- 10% equal pair-wise correlation between all assets in the portfolio.

Model RDR for Equally Weighted Portfolio of 300 Assets with 10% Flat Pair-Wise Correlation, Historical Corporate and CDO Default Tables

RDR	Asset Rating: B		Asset Rating: BB		Asset Rating: BBB	
	5 Year	10 Year	5 Year	10 Year	5 Year	10 Year
Model Output (%)						
Peak	38.2	47.9	21.0	28.8	4.9	9.3
AAA _{sf}	49.3	60.7	30.0	41.3	12.0	17.7
AA _{sf}	43.7	54.0	25.0	34.7	9.3	13.7
A _{sf}	38.7	49.0	21.3	30.3	7.3	11.3
BBB _{sf}	35.0	45.0	18.3	27.0	6.0	9.3
BB _{sf}	27.3	36.3	13.3	20.0	4.0	6.0
B _{sf}	22.0	30.3	10.0	16.0	2.7	4.3
Expected	14.0	23.7	5.8	11.8	1.4	3.2
Coverage of Mean						
AAA _{sf}	3.5	2.6	5.2	3.5	8.6	5.5
AA _{sf}	3.1	2.3	4.3	2.9	6.6	4.3
A _{sf}	2.8	2.1	3.7	2.6	5.2	3.5
BBB _{sf}	2.5	1.9	3.2	2.3	4.3	2.9
BB _{sf}	2.0	1.5	2.3	1.7	2.9	1.9
B _{sf}	1.6	1.3	1.7	1.4	1.9	1.3
Coverage of Peak						
AAA _{sf}	1.3	1.3	1.4	1.4	2.4	1.9
AA _{sf}	1.1	1.1	1.2	1.2	1.9	1.5
A _{sf}	1.0	1.0	1.0	1.1	1.5	1.2
BBB _{sf}	0.9	0.9	0.9	0.9	1.2	1.0
BB _{sf}	0.7	0.8	0.6	0.7	0.8	0.6
B _{sf}	0.6	0.6	0.5	0.6	0.5	0.5

RDR – Rating Default Rate. CDO – Collateralised debt obligation.
Source: Fitch Ratings

The table shows the historical peak default rate for each rating category and term. The peak default rates were based on the published data from three rating agencies. The second and the third tables show the multiple of the model RDR over the respective mean and peak default rate at each rating level. For example, a portfolio of 300 equally weighted 'BBB' assets with a 10-year term has a portfolio default rate at 'AAAsf' of 17.7%. The historical 'BBB' 10-year mean and peak default rates are 3.2% and 9.3%, respectively. The resulting multiple coverage of the mean default rate is 5.5x and of the peak default rate is 1.9x.

These results highlight some interesting properties of the model. Firstly, the multiples increase for shorter tenors and higher credit quality, which is mainly a result of the historical term structure and peak default rates.

The multiple coverage of the base default rate for sub-investment-grade ratings with the same correlation is less than 3.0x due to the higher than expected defaults. Secondly, the coverage of the mean and peak default rates at the 'BBBs' rating levels appear high relative to the 'AAAsf' coverage and the implied tiering between 'AAAsf' and 'BBBs' lower-rating CDO ratings is inconsistent between rating levels.

Therefore, the Following Adjustments were Applied to the Model:

1. Reduce correlation from 10% to 8%, in order to address the relatively high multiples at liability ratings of 'BBB' and below.
2. Lower the CDO default rates for 'AAAsf', and 'AAsf' and 'Asf', increases the level of confidence. This adjustment will compensate for the lower correlation assumption and maintain the RDR for 10-year 'AAAsf' and 'AAsf' rating levels. The two tables below show the empirical default rates and the target CDO default probability assumptions.
3. Floor the CDO default rates at 1bp, which mainly affects the short maturities. This adjustment was not part of the calibration but rather required to achieve convergence within the Monte Carlo Simulation. A level of confidence greater than 99.99% would require a very large number of simulations in order to achieve convergence.

Historical Default Rates (Adjusted Fitch Composite)

(%)	1	2	3	4	5	6	7	8	9	10
AAA	0.01	0.02	0.03	0.04	0.05	0.07	0.08	0.10	0.12	0.14
AA+	0.01	0.03	0.06	0.09	0.12	0.16	0.21	0.25	0.30	0.35
AA	0.02	0.05	0.09	0.15	0.21	0.28	0.36	0.44	0.53	0.63
AA-	0.02	0.06	0.12	0.19	0.28	0.37	0.48	0.60	0.72	0.86
A+	0.04	0.11	0.20	0.31	0.44	0.58	0.73	0.89	1.06	1.24
A	0.07	0.18	0.31	0.46	0.62	0.79	0.97	1.16	1.36	1.57
A-	0.12	0.28	0.46	0.66	0.88	1.11	1.34	1.59	1.84	2.10

Source: Fitch Ratings

Adjusted CDO Target Default Rates (Adjusted Fitch Composite AAAsf, AAsf, Asf CDO Default Rates)

(%)	1	2	3	4	5	6	7	8	9	10
AAAsf	0.01	0.01	0.01	0.02	0.03	0.04	0.04	0.05	0.06	0.08
AA+sf	0.01	0.01	0.02	0.03	0.04	0.05	0.07	0.09	0.11	0.13
AAsf	0.01	0.01	0.03	0.05	0.07	0.10	0.13	0.16	0.20	0.24
AA-sf	0.01	0.02	0.05	0.08	0.12	0.16	0.21	0.26	0.32	0.39
A+sf	0.01	0.04	0.08	0.14	0.20	0.28	0.37	0.47	0.58	0.70
Asf	0.02	0.07	0.13	0.21	0.31	0.41	0.53	0.66	0.80	0.95
A-sf	0.05	0.13	0.24	0.37	0.52	0.68	0.86	1.05	1.25	1.46

CDO - Collateralised debt obligation.

Source: Fitch Ratings

Model RDR for Equally Weighted Portfolio of 300 Assets with 8% Flat Pair-Wise Correlation, Adjusted CDO Default Tables

RDR	Asset Rating: B		Asset Rating: BB		Asset Rating: BBB	
	5 Year	10 Year	5 Year	10 Year	5 Year	10 Year
Model Output (%)						
Peak	38.2	47.9	21.0	28.8	4.9	9.3
AAA _{sf}	47.0	58.7	28.0	39.3	11.0	17.0
AA _{sf}	43.7	54.3	25.3	35.3	9.7	14.3
A _{sf}	38.3	48.7	21.3	30.3	7.7	11.3
BBB _{sf}	32.3	42.7	16.7	25.3	5.3	8.7
BB _{sf}	25.7	35.0	12.3	19.3	3.7	6.0
B _{sf}	21.3	29.7	9.7	15.7	2.7	4.3
Expected	14.0	23.7	5.8	11.8	1.4	3.2
Coverage of Mean						
AAA _{sf}	3.4	2.5	4.8	3.3	7.9	5.3
AA _{sf}	3.1	2.3	4.4	3.0	6.9	4.5
A _{sf}	2.7	2.1	3.7	2.6	5.5	3.5
BBB _{sf}	2.3	1.8	2.9	2.1	3.8	2.7
BB _{sf}	1.8	1.5	2.1	1.6	2.6	1.9
B _{sf}	1.5	1.3	1.7	1.3	1.9	1.3
Coverage of Peak						
AAA _{sf}	1.2	1.2	1.3	1.4	2.2	1.8
AA _{sf}	1.1	1.1	1.2	1.2	2.0	1.5
A _{sf}	1.0	1.0	1.0	1.1	1.6	1.2
BBB _{sf}	0.8	0.9	0.8	0.9	1.1	0.9
BB _{sf}	0.7	0.7	0.6	0.7	0.7	0.6
B _{sf}	0.6	0.6	0.5	0.5	0.5	0.5

RDR – Rating Default Rate. CDO – Collateralised debt obligation.
Source: Fitch Ratings

Historical rates for ‘AAA’, ‘AA’ and ‘A’ rating levels are based on small cohort portfolios with very few defaults. As a result, the historical default rates at ‘AAA_{sf}’, ‘AA_{sf}’ and ‘A_{sf}’ are strongly influenced by event risk in the cohort portfolios².

In other words, one idiosyncratic default in these small cohorts can have an outsized effect on the observed default rate. The input default probabilities for issuers with rating levels of ‘AAA’, ‘AA’ and ‘A’ are nevertheless based on the empirically observed default rates, in order to incorporate possible event risk among the underlying corporates.

Moreover, the adjustment to correlation and the CDO target default rates is equivalent to tiering the correlation assumptions by rating stress. In other words, for rating levels of ‘BBB_{sf}’ and below, Fitch assumes an equivalent correlation of 8%, while for higher rating levels the effective equivalent correlation is higher, between 8% and 10%.

² Since the historical default data are insufficient to obtain statistically significant differences by industries, Fitch assumed the performance of different industry classes would be similar in a stressed environment. Therefore, in the model, the intra industry correlation was assumed to be the same for each of the industries and industry sectors.

Industry Concentration and the Corporate Correlation Model

This report has so far focused on randomly selected portfolios diversified across industries. A flat pair-wise correlation is not sufficient to distinguish between well diversified portfolios and those with concentrations in particular industries or countries. Fitch believes that industry concentration within a credit portfolio could significantly increase the volatility of portfolio default rates.

In order to distinguish between diversified and concentrated portfolios the one factor model was extended to a multi-factor model. All of the factors are independent standard normal random variables. The following equation illustrates the correlation model.

$$Y_i = \alpha F_{Global} + \beta F_{Region} + \gamma F_{country} + \kappa F_{Glob_IndSector} + \delta F_{Glob_Industry} + \varphi F_{Local_Industry} + \omega \varepsilon_i$$

$$\omega = \sqrt{1 - \alpha^2 - \beta^2 - \gamma^2 - \kappa^2 - \delta^2 - \varphi^2}$$

The correlation assumptions are differentiated based on geography (region and country) and industry sector/industry. Industries are further separated depending on exposure to global and local performance drivers. The correlation framework is additive and any additional commonality between two assets adds a correlation uplift to the pair-wise correlation level of these two assets. The uplifts are given as the square of the factor exposures, i.e. $\alpha^2; \beta^2; \gamma^2; \delta^2; \varphi^2$.

PCM Industry Sectors and Industries; Main Countries and Regions

Sectors and Industry breakdown	Country	Region
Telecom media and technology – sector	Australia	Australia & New Zealand
Technology hardware	New Zealand	Australia & New Zealand
Technology software	Hong Kong	Developed Asia
Telecommunications	Japan	Developed Asia
Broadcasting and media	Singapore	Developed Asia
Cable	South Korea	Developed Asia
Industrials – sector	Taiwan	Developed Asia
Aerospace and defence	Austria	Europe Central
Automobiles	Belgium	Europe Central
Building and materials	France	Europe Central
Chemicals	Germany	Europe Central
Industrial and manufacturing	Liechtenstein	Europe Central
Metals and mining	Luxembourg	Europe Central
Packaging and containers	Netherlands	Europe Central
Real estate	Switzerland	Europe Central
Transportation and distribution	Denmark	Europe North
Retail leisure and consumer – sector	Finland	Europe North
Consumer products	Iceland	Europe North
Environmental services	Norway	Europe North
Food, beverage and tobacco	Sweden	Europe North
Retail food and drug	Cyprus	Europe South
Gaming and leisure and entertainment	Gibraltar	Europe South
Retail	Greece	Europe South
Healthcare devices	Italy	Europe South
Healthcare providers	Malta	Europe South
Lodging and restaurants	Portugal	Europe South
Pharmaceuticals	Spain	Europe South
	Ireland	Europe UK & Ireland
	Jersey	Europe UK & Ireland

Source: Fitch Ratings

PCM Industry Sectors and Industries; Main Countries and Regions

Sectors and industry breakdown	Country	Region
Energy – sector	UK	Europe UK & Ireland
Energy oil and gas	Canada	North America
Utilities power	US	North America
Banking and finance – sector		
Banking and finance		
Business services – sector		
Business services general		
Business services data and analytics		
Source: Fitch Ratings		

Other Countries and Regions in the Portfolio Credit Model

Country	Region	Country	Region
Argentina	Americas	Albania	Europe
Bahamas	Americas	Bosnia and Herzegovina	Europe
Barbados	Americas	Bulgaria	Europe
Brazil	Americas	Croatia	Europe
Chile	Americas	Czech Republic	Europe
Colombia	Americas	Eastern Europe Others	Europe
Costa Rica	Americas	Estonia	Europe
Dominican Republic	Americas	Hungary	Europe
Ecuador	Americas	Kazakhstan	Europe
El Salvador	Americas	Latvia	Europe
Guatemala	Americas	Lithuania	Europe
Jamaica	Americas	Macedonia	Europe
Mexico	Americas	Moldova	Europe
Other Central America	Americas	Poland	Europe
Other South America	Americas	Romania	Europe
Panama	Americas	Russia	Europe
Peru	Americas	Serbia and Montenegro	Europe
Puerto Rico	Americas	Slovakia	Europe
Uruguay	Americas	Slovenia	Europe
Venezuela	Americas	Ukraine	Europe
Asia Others	Asia	Egypt	Middle East and Africa
China	Asia	Iran	Middle East and Africa
India	Asia	Israel	Middle East and Africa
Indonesia	Asia	Liberia	Middle East and Africa
Malaysia	Asia	Middle East and North Africa Others	Middle East and Africa
Marshall Islands	Asia	Morocco	Middle East and Africa
Mauritius	Asia	Other Sub-Saharan Africa	Middle East and Africa
Pakistan	Asia	Qatar	Middle East and Africa
Philippines	Asia	Saudi Arabia	Middle East and Africa
Thailand	Asia	South Africa	Middle East and Africa
Vietnam	Asia	Tunisia	Middle East and Africa
		Turkey	Middle East and Africa
		Bermuda	North America
		Cayman Islands	North America
Source: Fitch Ratings			

For example, the pair-wise correlation between the latent variables of two assets from the same region but different countries and industries is given by $\alpha^2 + \beta^2$. Similarly, if two assets come from different regions but the same industry, their pair-wise correlation is equal to $\alpha^2 + \delta^2$. The uplift for local industries is only applied if two assets come from the same country and the same industry. The final correlation uplifts are detailed in the *Correlation Framework* table.

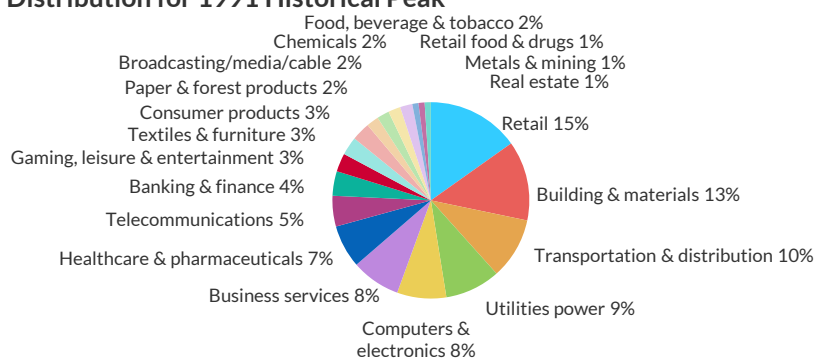
The *PCM Industry Sectors and Industries; Main Countries and Regions* table shows country and industry mapping in the PCM. Every non-EM country is mapped to one of seven regions and one of six industry sectors. The six industry sectors are further broken down into 29 industry classes. Two assets within an industry receive the same uplift in correlation regardless of whether they are within the same country or not. The global industry effect is assumed to dominate the performance of these credits. A good example would be two oil companies that are heavily dependent on the spot price of oil.

Calibration of Industry and Industry Sector Correlation for a US Portfolio

The calibration of the industry correlation model was again based on historical default rates as published in cohort studies. Since the majority share of the data is US-based, the calibration of the intra- and inter-industry correlation assumptions were done for a large randomly selected US portfolio, thereby replicating the cohort portfolios of historical default studies.

The base calibration in the previous section was focused on historical mean and peak default rates. For example, RDR for the 'Asf' rating stress level was expected to cover the historically observed peak default rate. Since the historical peak default rates included some industry concentration this had to be taken into account for calibrating the industry correlation model. While the largest industry concentration was seen in 2001-2002 cohorts, which had a large exposure to telecommunications, previous peak cohorts did not exhibit the same level of concentration. Fitch, therefore, used the less concentrated industry distribution of the 1991 peak cohort as shown in the chart below.

Industry Distribution for 1991 Historical Peak



Source: Fitch Ratings

We used default rates observed for the telecom sector for the period of 2001, 2002 and 2003, during which this sector underwent the most severe stress observed in any corporate sector in the last decade. Our analysis showed during this time, of the 158 US issuers in this sector, 78 defaulted in these three years, yielding a default rate of 49.4%. The rating profile of the sector is shown below:

Rating	BBB-	BB+	BB	BB-	B+	B	B-	CCC	CC	NR
#Issuers	2	2	8	2	12	24	37	39	1	31

Source: Fitch Ratings

The following table shows the RDR produced by PCM for a single sector, equally weighted US portfolio, with a three-year term and a rating distribution as shown above. Issuers that were not rated were assumed to be rated 'BB'. The pairwise correlation levels were 28%. The RDR for the 'Asf' rating stress covers the observed default rate within this sector.

Rating Default Rate Model Output (%)	3 Year
AAA _{sf}	67.7
AA _{sf}	63.3
A _{sf}	53.2
BBB _{sf}	40.5
BB _{sf}	27.9
B _{sf}	19.0
Expected	7.9

Source: Fitch Ratings

The calibration of the industry correlation model was intended to: yield results for the 1991 peak portfolio that were the same or close to RDR levels given by base calibration in the previous section; and produce increases in the RDR and the multiple coverage for industry and sector concentrations when compared to a diverse portfolio. The calibration was based on three benchmark portfolios.

Portfolio One – 1991 Peak

- 300 equally weighted assets with the same term and rating.
- Single-country US portfolio.
- Industry distribution as observed during the 1991 peak cohort.

Portfolio Two – Diverse

- 300 equally weighted assets with the same term and rating.
- Single-country US portfolio.
- Equal share in each of the 29 corporate industries.

Portfolio Three – 30% Industry Concentration

- 300 assets with the same term and rating.
- Single-country US portfolio.
- 30% in banking and finance; remainder diverse across other industries.

Model RDR for 1991 Peak Portfolio

RDR Model Output (%)	Asset Rating: B		Asset Rating: BB		Asset Rating: BBB	
	5 Year	10 Year	5 Year	10 Year	5 Year	10 Year
Peak	38.2	47.9	21.0	28.8	4.9	9.3
AAA _{sf}	47.3	58.7	28.3	39.7	11.7	17.3
AA _{sf}	44.0	54.7	25.7	35.7	10.3	14.7
A _{sf}	38.7	48.7	21.7	30.3	8.0	11.7
BBB _{sf}	32.7	43.0	17.0	25.3	5.7	9.0
BB _{sf}	26.0	35.0	12.7	19.3	3.7	6.0
B _{sf}	21.3	30.0	9.7	15.7	2.7	4.3
Expected	14.0	23.7	5.8	11.8	1.4	3.2

Coverage of Mean

AAA _{sf}	3.4	2.5	4.9	3.4	8.4	5.4
AA _{sf}	3.1	2.3	4.4	3.0	7.4	4.6
A _{sf}	2.8	2.1	3.7	2.6	5.7	3.7
BBB _{sf}	2.3	1.8	2.9	2.1	4.1	2.8

Model RDR for 1991 Peak Portfolio

RDR	Asset Rating: B		Asset Rating: BB		Asset Rating: BBB	
	5 Year	10 Year	5 Year	10 Year	5 Year	10 Year
BBsf	1.9	1.5	2.2	1.6	2.6	1.9
Bsf	1.5	1.3	1.7	1.3	1.9	1.3
Coverage of Peak						
AAAsf	1.2	1.2	1.3	1.4	2.4	1.9
AAsf	1.2	1.1	1.2	1.2	2.1	1.6
Asf	1.0	1.0	1.0	1.1	1.6	1.3
BBBsf	0.9	0.9	0.8	0.9	1.2	1.0
BBsf	0.7	0.7	0.6	0.7	0.7	0.6
Bsf	0.6	0.6	0.5	0.5	0.5	0.5

RDR – Rating Default Rate. Note: Equally weighted portfolio of 300 US assets with correlation assumptions: base 2%; industry sector uplift 2% and industry uplift of 20%.
Source: Fitch Ratings

Model RDR for Diverse Portfolio

RDR	Asset Rating: B		Asset Rating: BB		Asset Rating: BBB	
	5 Year	10 Year	5 Year	10 Year	5 Year	10 Year
Model Output (%)						
Peak	38.2	47.9	21.0	28.8	4.9	9.3
AAAsf	45.0	56.7	26.7	37.7	10.3	16.0
AAsf	42.0	52.7	24.0	34.0	9.3	13.7
Asf	37.0	47.3	20.3	29.0	7.3	11.0
BBBsf	31.3	41.7	16.3	24.7	5.3	8.7
BBsf	25.3	34.3	12.3	19.0	3.7	6.0
Bsf	21.0	29.7	9.7	15.3	2.7	4.3
Expected	14.0	23.7	5.8	11.8	1.4	3.2

RDR – Rating Default Rate. Note: Equally weighted portfolio of 300 US assets with correlation assumptions: base 2%; industry sector uplift 2% and industry uplift of 20%.
Source: Fitch Ratings

The tables show the results for each of the benchmark portfolios with a base level correlation of 6%, an industry sector uplift of 2% and an industry uplift of 20%. For example, two assets in the same industry would have a pair-wise correlation of 28%, while two assets from different industries but within the same industry sector would have a pair-wise correlation of 8%.

As a result of higher intra-industry correlation and sector correlation uplift, the base level correlation for the US was reduced to 6% from the 8% in the examples above, in order to maintain the results from the previous section for portfolio one. The chosen correlation levels closely replicate the results shown in Figure 26. The same correlation assumptions were also applied to the second calibration portfolio which was fully diverse and included an equal share in each of the 29 corporate industries.

Model RDR for Industry Concentrated Portfolio (30% Industry Concentration)

RDR	Asset Rating: B		Asset Rating: BB		Asset Rating: BBB	
	5 Year	10 Year	5 Year	10 Year	5 Year	10 Year
Model Output (%)						
Peak	38.2	47.9	21.0	28.8	4.9	9.3
AAAsf	49.0	60.0	30.7	41.3	13.7	19.3
AAsf	45.7	55.7	27.7	37.0	11.7	16.0
Asf	40.0	50.0	23.0	31.7	8.7	12.3
BBBsf	33.7	43.7	18.0	26.3	6.0	9.3
BBsf	26.7	35.3	13.0	19.7	3.7	6.0
Bsf	21.7	30.0	9.7	15.7	2.7	4.3
Expected	14.0	23.7	5.8	11.8	1.4	3.2

RDR – Rating Default Rate. Note: Equally weighted portfolio of 300 US assets with correlation assumptions: base 2%; industry sector uplift 2% and industry uplift of 20%.
Source: Fitch Ratings

The RDRs for portfolios with sizable industry concentrations are significantly higher compared with a fully diversified portfolio.

Calibration for Regionally Diverse Portfolios

The available default data outside the US is limited and does not prove whether a regionally diverse portfolio would perform differently to a portfolio of only US assets. However, it is Fitch's view that diversification can be achieved across regions. Therefore, the base level correlation for assets from different regions is lowered to four percentage points (pp), with an uplift of 2% for all non-EM regions. This recovers the 6% base level correlation for North America, while giving limited diversification benefit for assets from different regions. The results shown in the tables remain unchanged for an all-US portfolio.

Furthermore, Fitch believes that portfolios concentrated in any single country outside the US could have more volatile default rates than a portfolio diversified across the US. Therefore, the base level correlation in the model for any two non-US assets within the same country is increased by 4%. For example, the pair-wise correlation between two German assets from different industries would be 10%, which compares with the 6% between two similar US assets.

Since western Europe is split into four regions in the PCM the regional benefit, together with the country correlation uplift, balance each other out and results in a portfolio diversified across western European countries being treated similar to an all US portfolio of similar assets. Fitch recognizes that the correlation structure is only a model and, like other models, relies on assumptions. However, the model is designed to differentiate between concentrated and diverse portfolios.

Fitch's corporate correlation assumptions are shown in the *Correlation Framework* table above. The *Model RDR for 1991 Peak Portfolio – Single Country (Non-US)* table and *Model RDR for 1991 Peak Portfolio – Diversified Across Five European Countries* table provide results for the large homogenous and randomly chosen benchmark non-US portfolios, using the full correlation structure.

The *Model RDR for 1991 Peak Portfolio – Single Country (Non-US)* table shows results for a single country portfolio, outside North America, which compares to the *Model RDR for 1991 Peak Portfolio* table. The RDRs are higher for non-US single-country concentrations, reflecting our expectations such portfolios may be subject to more volatile portfolio default rates than a diversified US portfolio.

Model RDR for 1991 Peak Portfolio – Single Country (Non-US)

	Asset Rating: B		Asset Rating: BB		Asset Rating: BBB	
	5 Year	10 Year	5 Year	10 Year	5 Year	10 Year
Model Output (%)						
Peak	38.2	47.9	21.0	28.8	4.9	9.3
AAA _{sf}	56.3	67.0	35.7	47.7	15.7	22.3
AA _{sf}	52.0	62.0	32.0	42.3	13.3	18.7
A _{sf}	45.7	55.0	26.3	35.7	10.0	14.0
BBB _{sf}	37.7	47.7	20.3	29.0	7.0	10.3
BB _{sf}	29.0	37.7	14.3	21.0	4.3	6.3
B _{sf}	23.0	31.0	10.3	16.3	2.7	4.3
Expected	14.0	23.7	5.8	11.9	1.4	3.2

RDR – Rating Default Rate.
Source: Fitch Ratings

The *Model RDR for 1991 Peak Portfolio – Diversified Across Five European Countries* table shows the results for a portfolio with no industry concentrations, which is diversified across western European countries. Here the results are comparable with a diversified US portfolio, as shown in *Model RDR for Diverse Portfolio* table.

Model RDR for 1991 Peak Portfolio – Diversified Across Five European Countries

	Asset Rating: B		Asset Rating: BB		Asset Rating: BBB	
	5 Year	10 Year	5 Year	10 Year	5 Year	10 Year
Model Output (%)						
Peak	38.2	47.9	21.0	28.8	4.9	9.3
AAA _{sf}	49.0	60.7	30.0	41.3	12.7	18.3
AA _{sf}	45.7	56.3	27.0	37.0	10.7	15.7
A _{sf}	40.3	50.0	22.7	31.7	8.3	12.3
BBB _{sf}	33.7	44.0	17.7	26.3	6.0	9.3
BB _{sf}	26.7	35.7	13.0	19.7	4.0	6.0
B _{sf}	21.7	30.3	10.0	15.7	2.7	4.3
Expected	14.0	23.7	5.8	11.9	1.4	3.2

RDR – Rating Default Rate.
Source: Fitch Ratings

Appendix 4: Standard Recovery Rate Assumptions

The assumptions are applied per rating category, e.g. for the 'A+sf' rating level, the assumption shown in the column 'Asf' is applied. In instances where Fitch provided asset-specific RRs and a specific recovery estimate, then the recovery rate assumption will be interpolated based on the assumptions for the recovery estimate, as shown in the *Asset-Specific Recovery Rate Assumptions* table.

Asset-Specific Recovery Rate Assumptions Group 1 and 2

Recovery Rating (%)	AAA _{sf}	AA _{sf}	As _f	BBB _{sf}	BB _{sf}	B _{sf}
RR1 (outstanding: 91-100%)	60	70	80	90	95	95
RR2 (superior: 71-90%)	45	55	65	75	80	85
RR3 (good: 51-70%)	30	35	45	55	60	65
RR4 (average: 31-50%)	10	15	20	25	40	45
RR5 (below average: 11-30%)	0	5	10	15	20	25
RR6 (poor: 0-10%)	0	0	0	0	5	5

Source: Fitch Ratings

Asset-Specific Recovery Rate Assumptions – Group 3

Recovery Rating (%)	AAA _{sf}	AA _{sf}	As _f	BBB _{sf}	BB _{sf}	B _{sf}
RR1	5	10	30	50	70	90
RR2	5	10	20	35	50	70
RR3	0	5	15	25	35	50
RR4	0	0	5	10	20	30
RR5	0	0	0	0	5	10
RR6	0	0	0	0	0	0

Source: Fitch Ratings

For assets without Fitch-assigned recovery rates, recovery assumptions will primarily be based on the seniority of the actual debt instrument and issuer type, as detailed in the *Recovery Rate Assumptions* table. Senior secured loans from non-middle-market entities, issuers with a public rating from Fitch, Moody's or S&P, correspond to "Strong recovery". Senior secured bonds correspond to their named category and senior unsecured bonds correspond to "Moderate recovery". Other debt instruments, including second-lien loans, will commonly be categorised as "Weak recovery". However, where actual recovery experience is less than might be expected for the level of seniority, a lower categorisation may be used in specific cases.

Senior secured loans from Group 1 issuers that do not have a public rating from Fitch, Moody's or S&P will correspond to the "Strong recovery MML" category. Non-senior secured loans from middle market Group 1 issuers will correspond to the "Weak recovery" category. However, for loans from issuers in Group 1 countries that have received a private rating or credit opinion from Fitch and include a Fitch-assigned recovery estimate or recovery rating, the Fitch-assigned recovery estimate or recovery rating will be used to determine a recovery assumption. In the absence of a Fitch-assigned recovery estimate or recovery rating, loans from these issuers will be considered middle-market loans.

US issuers that file for bankruptcy often issue debtor-in-possession (DIP) instruments with instrument recovery expectations likely to be higher than the pre-petition loans from the borrower. As a majority of DIP instruments are expected to perform better than the pre-petition loans of a bankrupt borrower, Fitch will incorporate a recovery assumption in line with an RR of 'RR1', where it identifies a loan as a DIP instrument. The PCM also includes recovery assumptions for sovereign exposures, which may be used for, e.g. state-owned enterprises. The recovery assumptions are published in *Covered Bonds and CDOs Public Entities Asset Analysis Rating Criteria*.

Recovery Rate Assumptions

Recovery Prospects (%)	AAAsf	AAsf	Asf	BBBsf	BBsf	Bsf
Group 1 – US mainly						
Strong recovery	40	50	60	70	75	80
Strong recovery MML	35	40	50	60	65	70
Senior secured bonds	30	35	45	55	60	65
Moderate recovery	10	15	20	25	40	45
Weak recovery	0	0	5	10	15	20
Group 2 – Europe						
Strong recovery	35	40	50	60	65	70
Senior secured bonds	30	35	45	55	60	65
Moderate recovery	10	15	20	25	40	45
Weak recovery	0	0	5	10	15	20
Group 3 – Other						
Strong recovery	5	10	15	20	30	35
Moderate recovery	0	0	5	10	20	25
Weak recovery	0	0	0	0	5	5

MML – Middle market loan.
Source: Fitch Ratings

Group 1

Australia, Bermuda, Canada, Cayman Islands, New Zealand, Puerto Rico, United States.

Group 2

Austria, Barbados, Belgium, Czech Republic, Denmark, Estonia, Finland, France, Germany, Gibraltar, Hong Kong, Iceland, Ireland, Israel, Italy, Japan, Jersey, Latvia, Liechtenstein, Lithuania, Luxembourg, Netherlands, Norway, Poland, Portugal, Singapore, Slovakia, Slovenia, South Korea, Spain, Sweden, Switzerland, Taiwan, UK.

Group 3

Albania, Argentina, Asia Others, Bahamas, Bosnia and Herzegovina, Brazil, Bulgaria, Chile, China, Colombia, Costa Rica, Croatia, Cyprus, Dominican Republic, Eastern Europe Others, Ecuador, Egypt, El Salvador, Greece, Guatemala, Hungary, India, Indonesia, Iran, Jamaica, Kazakhstan, Liberia, Macedonia, Malaysia, Malta, Marshall Islands, Mauritius, Mexico, Middle East and North Africa Others, Moldova, Morocco, Other Central America, Other South America, Other Sub Saharan Africa, Pakistan, Panama, Peru, Philippines, Qatar, Romania, Russia, Saudi Arabia, Serbia and Montenegro, South Africa, Thailand, Tunisia, Turkey, Ukraine, Uruguay, Venezuela, Vietnam.

Asset-Specific Recovery Rate Assumptions

Recovery Rating (%)	Interpolation Boundary	AAAsf	AAsf	Asf	BBBsf	BBsf	Bsf
	100	60	70	80	90	100	100
Group 1 and 2 RR1 (outstanding: 91-100%)	95	60	70	80	90	95	95
	90	55	65	75	85	90	90
	85	50	60	70	80	85	90
Group 1 and 2 RR2 (superior: 71-90%)	80	45	55	65	75	80	85
	75	40	50	60	70	75	80
	70	35	45	55	65	70	75
	65	35	40	50	60	65	70
Group 1 and 2 RR3 (good: 51-70%)	60	30	35	45	55	60	65
	55	25	30	40	45	55	60
	50	20	25	35	40	50	55
	45	15	20	25	35	45	50
Group 1 and 2 RR4 (average: 31-50%)	40	10	15	20	25	40	45
	35	5	10	15	20	35	40
	30	0	5	10	15	30	35
	25	0	5	10	15	25	30
Group 1 and 2 RR5 (below average: 11-30%)	20	0	5	10	15	20	25
	15	0	0	5	10	15	20
	10	0	0	0	5	10	15
Group 1 and 2 RR6 (poor: 0-10%)	5	0	0	0	0	5	5
	0	0	0	0	0	0	0
Recovery Estimate	67	35	42	52	62	67	72

RR – Recovery Rating.
Source: Fitch Ratings

Interpolation Example for Specific Recovery Estimates

In instances where Fitch is provided with a specific recovery estimate by the corporate group, the recovery assumptions will be interpolated between the closest two recovery ratings, based on the 'BBsf' column, which corresponds to the mid-point recovery rate for each RR band. We defined interpolation rows in 5pp increments. The interpolation is linear and based on the closest two rows. The last row in the table shows the resulting recovery rates for a recovery estimate of 67%.

Appendix 5: Fitch IDR Equivalency Map

For the purposes of analysing corporate CDOs, the Fitch IDR is one of the primary drivers of default probability for the underlying portfolio assets. In the absence of an IDR, Fitch will map to the equivalent IDR rating from the security rating of another instrument within the issuer's capital structure. Ratings assigned to guaranteed instruments will only be taken into account to the extent the underlying guarantee relates to the issuer, rather than the specific debt instrument. For example, a guarantee by a parent to a subsidiary, which leads to a higher rating for the debt issued by the subsidiary would be considered. On the other hand, a guarantee provided by a sovereign on the specific bond of a bank would be disregarded when deriving the IDR from the instrument rating.

In the event that Fitch does not provide any ratings or Credit Opinions for the issuer, public or private, we will look to the public ratings provided by Moody's or S&P. To determine the equivalent IDR rating from either Moody's or S&P, Fitch will apply the mapping illustrated below. If there are public ratings provided by both agencies, the lower of the two IDR equivalent ratings will be applied. Otherwise, the sole IDR equivalent rating from either Moody's or S&P will be applied. The IDR equivalent rating for all assets subject to a Negative Rating Watch is the credit rating minus one notch, with a floor of 'CCC-'. This adjustment is made prior to mapping from the issue rating to the IDR equivalent rating.

Fitch may provide a Credit Opinion on the issuer, attribute a rating of 'CCC' to the issuer or, depending on the issuer and/or portfolio characteristics, assume a rating other than 'CCC'. For example, if Fitch is aware that other agencies have a private rating higher than 'CCC+', unrated assets may be considered as 'B-' instead of 'CCC' if the share of unrated assets is sufficiently large to become a driver of the rating. Another example would be if an entity is classified as defaulted by any manager and there is insufficient public information available, Fitch would typically treat such credit exposures as 'D'.

Credit Opinions are generally point-in-time views and are not subject to monitoring or surveillance by the corporates team. CLO managers provide detailed reporting on a monthly basis, including defaulted issuers and issuers treated as 'CCC'. Trustee report data and/or major market- or company-specific events may prompt a reassessment of the Credit Opinion. Credit Opinions are assessed at least annually. If Credit Opinions cannot be assessed because of missing information within the 12-month timeframe, Fitch will assess the asset as a 'CCC' risk until an updated Credit Opinion is performed.

Fitch IDR Equivalency Map from Corporate Ratings

Rating Type	Rating Agency(s)	Issue Rating	Mapping Rule
Corporate family rating long-term issuer rating	Moody's	N.A.	0
Issuer credit rating	S&P	N.A.	0
Senior unsecured	Fitch, Moody's, S&P	Any	0
Senior debt: senior secured or subordinated secured	Fitch, S&P	BBB- or above	0
	Fitch, S&P	BB+ or below	-1
	Moody's	Ba1 or above	-1
	Moody's	Ba2 or below	-2
	Moody's	Ca	-1
Subordinated debt: junior subordinated or senior subordinated	Fitch, Moody's, S&P	B+, B1 or above	1
	Fitch, Moody's, S&P	B, B2 or below	2

N.A. – Not applicable.
Source: Fitch Ratings

The Following Steps Are Used to Calculate the Fitch IDR Equivalency Rating

1	Public Fitch LT IDR or LT IDCO.
2	If Fitch has not issued a LT IDR or LT IDCO, but has an outstanding IFSR, the Fitch IDR Equivalency Rating is one rating notch lower.
3	If Fitch has not issued a LT IDR, LT IDCO or IFSR, but has outstanding corporate issue ratings, the Fitch IDR Equivalency Rating is calculated using the Fitch IDR Equivalency Table.
4	If Fitch does not rate the issuer (LT IDR, LT IDCO, IFSR) or any associated issuance, it determines a Moody's and S&P equivalent to Fitch's LT IDR pursuant to steps 5 and 6.
5a	A public Moody's-issued CFR is equivalent in terms of definition to the Fitch LT IDR; if Moody's has not issued a CFR, but has a public LT issuer rating, this is equivalent to the Fitch LT IDR.
5b	If Moody's has not issued a CFR or LT issuer rating, but has a public insurance financial strength rating, the Fitch IDR Equivalency Rating is one rating notch lower.
5c	If Moody's has not issued a CFR, LT issuer rating or insurance financial strength rating, but has public corporate issue ratings, the Fitch IDR Equivalency Rating is calculated using the Fitch IDR Equivalency Table.
6a	A public S&P-issued ICR is equivalent in terms of definition to the Fitch LT IDR.
6b	If S&P has not issued an ICR, but has an outstanding insurance financial strength rating, the Fitch IDR Equivalency Rating is one rating notch lower.
6c	If S&P has not issued an ICR or insurance financial strength rating, but has public corporate issue ratings, the Fitch IDR Equivalency Rating is calculated using the Fitch IDR Equivalency Table.
7	If both Moody's and S&P provide a public rating on the issuer or an issue, the lower of the two Fitch IDR Equivalency Ratings will be used; otherwise the sole public Fitch IDR Equivalency Rating calculated from Moody's or S&P will be applied provided that if any rating described above is on Rating Watch Negative, the rating will be adjusted down by one rating notch before the Fitch IDR Equivalency Rating is determined.

LT IDR – Long-Term Issuer Default Rating. LT IDCO – Long-Term Issuer Default Credit Opinion. IFSR – Insurer Financial Strength Rating. CFR – Corporate Family Rating. ICR – Issuer Credit Rating.
Source: Fitch Ratings

Appendix 6: Calculation of Fitch WARF and Fitch WARR

The Fitch WARF is a numerical value that describes the weighted average credit quality of the portfolio. Each asset is assigned a numerical value with respect to the credit quality of that particular issuer. Fitch's rating factor scale equates to the 10-year asset default rate used in Fitch's PCM. The first step in calculating the Fitch WARF is to determine the Fitch IDR Equivalency Rating for each collateral obligation in the portfolio, in accordance with the process described in Appendix 5. We then multiply the notional balance of the asset by the Rating Factor associated with the Fitch IDR Equivalency Rating from the *Fitch WARF and WARR Scales* table below and sum these products. Finally, we divide the sum by the total notional balance of the portfolio.

The first step in calculating the Fitch WARR is to determine the recovery factor for each collateral obligation in the portfolio. We then multiply the notional balance of the asset by the recovery factor associated and sum these products. Finally, we divide the sum by the total notional balance of the portfolio. Our WARR for the portfolio is calculated using the recovery estimate value or recovery rating for the issue when available or the 'BBsf' rating stress assumption based upon seniority of the actual debt instrument and issuer type of each asset if a recovery estimate or recovery rating is unavailable. The table below displays the corresponding recovery factor for each instrument and issuer type.

Fitch WARF and WARR Scales

Fitch IDR Equivalency Rating	Rating Factor
AAA	0.136
AA+	0.349
AA	0.629
AA-	0.858
A+	1.237
A	1.572
A-	2.099
BBB+	2.630
BBB	3.162
BBB-	6.039
BB+	8.903
BB	11.844
BB-	15.733
B+	19.627
B	23.671
B-	32.221
CCC+	41.111
CCC	50.000
CCC-	63.431
CC	100.000
C	100.000
Fitch Recovery Classification – Group 1 and 2	Recovery Factor
RR1	95
RR2	80
RR3	60
RR4	40
RR5	20
RR6	5

Fitch WARF and WARR Scales

Fitch Recovery Classification	Recovery Factor
Group 1 – Strong	75
Group 1 – Strong US middle market loan	65
Group 1 – Senior secured bond	60
Group 1 – Moderate	40
Group 1 – Weak	15
Group 2 – Strong	65
Group 2 – Senior secured bond	60
Group 2 – Moderate	40
Group 2 – Weak	15
Group 3 – Strong	30
Group 3 – Moderate	20
Group 3 – Weak	5

WARF – Weighted average rating factor. WARR – Weighted average recovery rate. IDR – Issuer Default Rating.
Fitch IDR Equivalency Ratings of CC, 'C, and D are considered defaulted. Fitch Recovery Factors for Group 3 RR1, RR2, RR3, RR4, RR5 and RR6 are 70, 50, 35, 20, 5, and 0, respectively.
Source: Fitch Ratings

Appendix 7: Default Timings

Share of RDR (%)

Year ^a	WAL-1	WAL-2	WAL-3	WAL-4	WAL-5	WAL-6	WAL-7	WAL-8	WAL-9	WAL-10 and Above
Front-Loaded Default Timing										
1	100	50	50	44	41	37	35	33.5	33	32.5
2	-	50	35	30	27.5	24.5	23.5	22.5	22	21.5
3	-	-	15	13	10.5	10	9	8	7	6
4	-	-	-	13	10.5	10	9	8	7	6
5	-	-	-	-	10.5	10	9	8	7	6
6	-	-	-	-	-	8.5	9	8	7	6
7	-	-	-	-	-	-	5.5	8	7	6
8	-	-	-	-	-	-	-	4	6	6
9	-	-	-	-	-	-	-	-	4	6
10	-	-	-	-	-	-	-	-	-	4
Mid-Loaded Default Timing										
1	100	50	35	30	27.5	9.5	8	7	6	5
2	-	50	50	44	41	24.5	8.5	7.25	6	6
3	-	-	15	13	10.5	37	23.5	8	6	6
4	-	-	-	13	10.5	9.75	35	22.5	6	6
5	-	-	-	-	10.5	9.75	8.5	33.5	22	6
6	-	-	-	-	-	9.5	8.25	7.5	33	21.5
7	-	-	-	-	-	-	8.25	7.25	7	32.5
8	-	-	-	-	-	-	-	7	7	6
9	-	-	-	-	-	-	-	-	7	6
10	-	-	-	-	-	-	-	-	-	5
Back-Loaded Default Timing										
1	100	50	30	20	16	13	10	-	-	-
2	-	50	35	22.5	17	14	12.5	10	-	-
3	-	-	35	27.5	17	14	12.5	12.5	10	-
4	-	-	-	30	25	14	12.5	12.5	12.5	10
5	-	-	-	-	25	22.5	12.5	12.5	12.5	12.5
6	-	-	-	-	-	22.5	20	12.5	12.5	12.5
7	-	-	-	-	-	-	20	20	12.5	12.5
8	-	-	-	-	-	-	-	20	20	12.5
9	-	-	-	-	-	-	-	-	20	20
10	-	-	-	-	-	-	-	-	-	20

^aWe use these annual default curves and interpolate quarterly assumptions in our cash flow modelling. Within those interpolations, the WAL of the portfolio is rounded to the nearest quarter to determine the corresponding default timing curve. These quarterly default curves are available in Fitch's Portfolio Credit Model. RDR – Rating Default Rate. WAL – Weighted average life.
Source: Fitch Ratings

Appendix 8: Allocation of Defaults to Reinvestments

The table below illustrates how defaults are allocated to reinvestments. The example consists of a portfolio with an eight-year bullet maturity and a 30% default rate, applied over a mid-loaded default timing scenario. For simplicity, Fitch assumes USD10 of recovery proceeds are received and reinvested in year four.

The periodic default rate relative to the outstanding, rather than initial, performing balance of the portfolio is used to derive defaults in the reinvestment portfolio. Accordingly, the relative default rate applied to the remaining original portfolio from year four onward, when reinvestment occurs, is also applied to the reinvestment portfolio.

The relative default rate on the remaining portfolio from year four onward is equal to the sum of the portions of the initial 30% default rate applied in years four to eight (6.8%, 10.1%, 2.3%, 2.2% and 2.1% for a total of 23.3%) divided by the remaining portfolio balance in year four. This indicates a relative default rate on the remaining portfolio of $23.3/93.3 = 25\%$. This 25% default rate is then applied to the reinvestment portfolio over years four to eight, as displayed in row h in the table below.

Default Methodology Example

Row	Calculation								
a	Total default rate (%)	30.0	-	-	-	-	-	-	-
b	Year	1	2	3	4	5	6	7	8
c	Default timing (% of initial portfolio)	7.00	7.25	8.00	22.50	33.50	7.50	7.25	7.00
d	Outstanding performing portfolio (USD)	100.0	97.9	95.7	93.3	86.6	76.5	74.3	72.1
e	(c)x(a) Periodic default rate (% of initial portfolio)	2.1	2.2	2.4	6.8	10.1	2.3	2.2	2.1
f	(e)/(d) Periodic default rate (% of outstanding portfolio)	2.1	2.2	2.5	7.2	11.6	2.9	2.9	2.9
g	Outstanding reinvestment portfolio (USD)	-	-	-	10.0	9.3	8.2	8.0	7.7
h	(g)x(f) Default amount using periodic default rate (USD)	-	-	-	0.7	1.1	0.2	0.2	0.2

Source: Fitch Ratings

Appendix 9: Sample Asset Manager Operational Assessment Agenda

Organisation

- Firm background, legal/ownership structure overview.
- Assets under management (AUM) & business lines overview.
- CLO issuance strategy.
- Staffing summary.

CLO Portfolio Management and Loan Investment Process

- Team structure and process:
 - Team composition – number of portfolio managers (PMs)/analysts/support staff.
 - Profile of key executives and PMs.
 - PM/analyst responsibilities, lines of communication, frequency of team meetings.
 - Team workload – number of credits per analyst; division of labour between junior and senior analysts.
 - Articulation of loan investment process.
 - Asset screening/deal flow.
 - Credit write-up example.
 - Investment committee (composition, authority and approval process).
 - Overview of CLO management strategy and positioning.
- Loan monitoring:
 - Analyst responsibilities.
 - Processing of public information and quarterly filings.
 - Use of third-party information or proprietary technology to support credit analysis.
 - Frequency of credit meetings (scheduled or ad hoc).
 - Frequency of full portfolio reviews.
 - Internal process for managing credits.
 - ♦ Determining buy/sell, internal scoring/ratings.
 - ♦ Early-warning system, sale indicators.
 - ♦ Distressed credits.
- Portfolio Management Tools:
 - Overview of front-end system, other PM reports (demo or screenshots).
 - Strategies for portfolio optimisation (overview of current or future technology).
 - Overview of proprietary or third-party applications.
 - Interaction between PMs/credit team and systems and tools used.
 - Planned enhancements.

Technology/CLO Administration

- IT infrastructure and staff overview:
 - In-house vs. outsourced functions (CLO specific)
- Front/middle/back office systems integration:
 - Overview of key individuals and roles.
 - CLO compliance monitoring.
 - Pre-trade compliance process and PM communication with operations team.
 - Trustee monitoring (data files, frequency, reconciliation process); parallel testing of hypothetical trades.
 - Data feeds used for pricing, ratings, etc.
- Disaster recovery and business resumption plans:
 - Backup routines.
 - Overview of plan in the event of business disruption.
 - Cybersecurity measures.

Procedures and Controls (Specific to CLO Operations)

- Internal audit process.
- External audits, recent SEC examinations and material findings.
- Review frequency of policies and procedures manuals.

Appendix 10: RRR Interpolation Grids for Market Standard European Leveraged Loan CLOs and US Middle-Market CLOs

European CLOs and US middle-market CLOs include a matrix of different combinations of WARR, WARF and WAS covenants. Due to the size of the matrix it is not feasible for Fitch to create a bespoke stress portfolio for each WARR point. To analyse the covenant matrix, Fitch would create an interpolation table based on the minimum required senior secured exposure under the transaction documents. The *CLO RRR Grid for WARR<50%* table and the *CLO RRR Grid for WARR≥50%* table show the interpolation tables for a typical European or US middle market CLO transaction with at least 90% senior secured exposure.

For example, for a WARR covenant of 62.5% the RRR value for each rating stress would be interpolated as a midpoint between RRRs for a WARR of 60% and 65%. The 'BBBsf' RRR for the 62.5% WARR covenant will be 55.25%, i.e. the average between 52.0% and 58.5%, which are the 'BBBsf' RRR levels for the 60 WARR and 65 WARR shown in *CLO RRR Grid for WARR≥50%*.

CLO RRR Grid for WARR<50%

WARR Covenant (%)	0	5	10	15	20	25	30	35	40	45
AAA	0.00	0.00	0.00	0.70	2.60	4.30	6.10	7.90	9.70	14.40
AA	0.00	0.00	1.40	3.40	5.70	7.80	9.90	12.30	14.70	19.40
A	0.00	0.00	3.20	6.20	8.90	11.50	14.10	16.90	19.90	25.40
BBB	0.00	0.00	4.80	8.90	12.20	15.20	18.30	21.70	25.00	32.00
BB	0.00	4.60	9.70	14.60	20.00	25.10	29.50	34.60	40.00	44.60
B	0.00	4.90	12.00	18.00	23.70	29.10	34.00	39.40	44.90	50.00
CCC	0.00	4.90	12.00	18.00	23.70	29.10	34.00	39.40	44.90	50.00

RRR – Rating Recovery Rate. WARR – Weighted average recovery rate.
Source: Fitch Ratings

CLO RRR Grid for WARR≥50%

WARR Covenant (%)	50	55	60	65	70	75	80	85	90	95
AAA	19.00	23.30	29.00	33.50	36.70	40.50	44.90	50.30	54.30	59.50
AA	24.20	29.00	34.50	39.50	44.00	48.70	53.80	59.50	64.10	69.40
A	31.40	36.60	43.50	49.50	54.00	57.90	63.40	69.20	74.20	79.50
BBB	38.70	44.30	52.00	58.50	63.50	67.00	72.80	78.70	83.70	89.10
BB	49.50	54.10	58.70	63.80	68.70	73.30	78.50	84.40	89.00	94.40
B	54.90	59.40	64.00	68.60	73.40	77.70	82.60	87.10	91.40	94.90
CCC	54.90	59.40	64.00	68.60	73.40	77.70	82.60	87.10	91.40	94.90

RRR – Rating Recovery Rate. WARR – Weighted average recovery rate.
Source: Fitch Ratings

For a US BSL CLO that includes a Fitch WARR covenant, a committee may decide to use the tables above or an alternative grid that is based on the anticipated recovery distribution for the US BSL CLO. The alternative grid will be disclosed in the transaction's rating publication.

Appendix 11: Fitch Reporting

The publication of Fitch's analytical inputs in the regular CLO reporting for investors further strengthens our core principles – objectivity, independence, integrity, and transparency. The following is a list of asset-specific and portfolio attributes.

- Fitch Long-Term IDR (LT IDR) or Long-Term Issuer Default Credit Opinion (LT IDCO^a), Watch or Outlook status and effective date, if publicly available.
- Fitch RR or Credit Opinion RR if publicly available.
- Fitch Industry classification, if publicly available.
- Fitch IDR Equivalency Rating^b.
- Fitch Rating Factor in line with Appendix 6.
- Fitch Recovery Classification in line with Appendix 6.
- Fitch Recovery Factor in line with Appendix 6.
- Current Fitch WARF in line with Appendix 6.
- Maximum Fitch WARF test covenant, if applicable.
- Current Fitch WARR in line with Appendix 6.
- Minimum Fitch WARR test covenant, if applicable.
- Total notional balance of assets with a Fitch IDR or IDCO of 'CCC+' or lower.
- Concentration of assets with a Fitch IDR or IDCO of 'CCC+' or lower expressed as a percentage of all assets.
- Total notional balance of assets with a Fitch IDR Equivalency Rating of 'CCC+' or lower.
- Concentration of assets with a Fitch IDR Equivalency Rating of 'CCC+' or lower expressed as a percentage of all assets.
- Largest Fitch industry concentration expressed as a percentage of all assets.
- Second-largest Fitch industry concentration expressed as a percentage of all assets.
- Third-largest Fitch industry concentration expressed as a percentage of all assets.
- Notional balance of asset.
- Asset maturity date.
- Asset name.
- Asset identifier (CUSIP, ISIN, LX ID, LIN, or FIGI).
- Obligor name.
- Total notional balance of all assets.
- Total balance of cash.
- Eligible investments.
- Total notional balance of defaulted assets.
- Concentration of defaulted assets expressed as a percentage of all assets.

^aFitch IDCO should be shown in lower case with an asterisk. For example, "b-*".

^bCollateral obligations have a Fitch IDR Equivalency Rating

Appendix 12: US Middle Market CLO Asset Level Information

Information for Assignment of Issuer Credit Opinions:

The following issuer specific information is typically provided by the CLO asset manager to Fitch at least annually and is used by Fitch's corporate group to assign point in time Credit Opinions that are an input into the CLO note rating analysis for US Middle Market CLOs.

1. Credit agreement and amendment documents since acquiring collateral obligations or since last submission for credit opinion update; intercreditor agreement if applicable
2. For financial Institutions and Insurance issuers, three years of audited financials. Audited financials should be audited by an accounting firm registered with and in good standing with the Public Company Accounting Oversight Board (PCAOB).
3. For issues in other industries, audited & interim financial statements since latest submission
4. Covenant compliance since latest submission

Fitch may require additional information/documentation to complete the analysis.

Notification Events;

The CLO asset manager should provide notice to Fitch upon occurrence of any of the following list of events. Notifications should indicate the issuer name and specify the type of event that has occurred. Updated information received from these notices may be used to complete analysis for a new point-in-time Credit Opinion.

1. Failure to pay principal or interest when due
2. Reduction or forgiveness of any principal amount of the collateral obligation
3. Reduction or increase in interest rate by borrower of the collateral obligation, not provided for in the original credit agreement
4. Permission to defer or capitalize interest due on the collateral obligation unless permitted in the initial credit agreement
5. Maturity extension of collateral obligation
6. Restructurings, new debt issues, repayment of debt by borrower of the collateral obligation
7. Significant sales or acquisitions by borrower of the collateral obligation
8. A breach or waiver of covenants under the collateral obligation
9. Any other material amendment, consent, modification or waiver of the terms in the credit agreement

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