Aviation Finance Rating Methodology

Project Finance

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Contacts

Helene Spro
Director
+49-69-66-77389-90
h.spro@scoperatings.com

Christian Vogel
Director
+49 40 524724-101
c.vogel@scoperatings.com

Dr Stefano Mostarda
Director
+49-30-27891-259
s.mostarda@scoperatings.com

Torsten Schellscheidt
Managing Director
+49-40-524724-100
t.schellscheidt@scoperatings.com

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1 Introduction

This document provides the latest update to Scope Ratings' Aviation Finance Rating Methodology. The updates to the document primarily relate to the merger of the Aircraft Non-payment Insurance Methodology (NPI methodology) into this methodology. To this end, section 9 was created, which describes the rating approach for aircraft finance transactions protected by non-payment insurance that was previously covered by the NPI methodology. The update also makes explicit in the legal analysis the approach to aircraft engine (and other parts) pooling and aircraft subleasing in section 11.2, as well as some editorial changes and clarifications to improve consistency and understanding.

2 Areas of application

This document describes our methodology for the rating of instruments secured by commercial aircraft, generally referred to throughout this document as *aviation finance transactions.* It also describes an additional analytical layer to aviation finance transactions which is referred to as the *Aircraft Non-payment Insurance Rating framework* (*NPI framework).* This framework covers aircraft finance transactions protected with non-payment insurance.

Aviation finance transactions are typically issued by a special-purpose vehicle (SPV) or as a direct loan to an airline or lessor to finance the acquisition of one or several aircraft.

The methodology will be applied to transactions with multiple aircraft if the following applies: i) The aircraft are cross-collateralised; ii) the aircraft have the same characteristics (body and phase); iii) the aircraft leases are comparable in regard to risks, liabilities and obligations of the airline; iv) the risk presenter/obligor is the same for all aircraft.

The focus of this methodology is debt issued with the intention of financing or refinancing of aircraft exposed to a single airline. This methodology is not applicable to rating aircraft operators, aviation lessors, securitisation of a pool of aircraft leases or airport financing transactions.

This methodology takes a world-wide approach and can be applied to aircraft financing transactions globally.

The aviation finance methodology will be applied in conjunction with our General Structured Finance Rating Methodology when portfolios of credit exposures to several different aircraft finance transactions are securitised in an SPV. For details on the analysis of legal and tax risks and the consideration of third party credit enhancements (e.g. guarantees), refer to Appendix XI of our General Project Finance Rating Methodology. For details on the counterparty assessment of financial counterparties, refer to our Counterparty Risk Methodology. For details on the treatment of a probability of default that is considered high relative to the expected loss, please refer to Appendix IV Technical note on timely payment in our General Structured Finance Rating Methodology. For details of the Scope's portfolio model, please refer to Appendix III of our General Structured Finance Rating Methodology.

3 Rating definitions

Our aviation finance credit ratings constitute a forward-looking opinion on relative credit risk. See our rating definitions available on our website. An aviation finance rating reflects the expected loss associated with payments contractually promised under a credit exposure to commercial aircraft, by its legal maturity, accounting for the time value of money at the rate promised to the investor. The credit risk of the lease is passed through to the acquisition loan, as a lease default normally results in an acquisition loan default. The existence of non-payment insurance can prevent a default on the loan for a predetermined period of time.

The expected loss in this methodology reflects, in turn: i) the likelihood of a contract default reducing payments promised to the investor; and ii) the loss severity expected upon a default. We assess the likelihood of default and will limit the rating if an instrument has a very low expected loss and very high default likelihood. We apply the timely payment standards highlighted in Appendix I when assigning expected loss ratings under this methodology. For more details, refer to the technical notes on the expected loss framework and timely payment under 8.1 and Appendix I.

For our quantitative analysis, we calculate an instrument's expected loss over an expected risk horizon, with the result benchmarked against our idealised expected loss table. The table is available on our website[1].

4 Methodology highlights

Expected loss. Our aviation finance ratings reflect the expected loss on a debt instrument secured by commercial aircraft. This methodology focuses especially on the analysis of the severity to the investor by estimating recovery rates after an event of default.

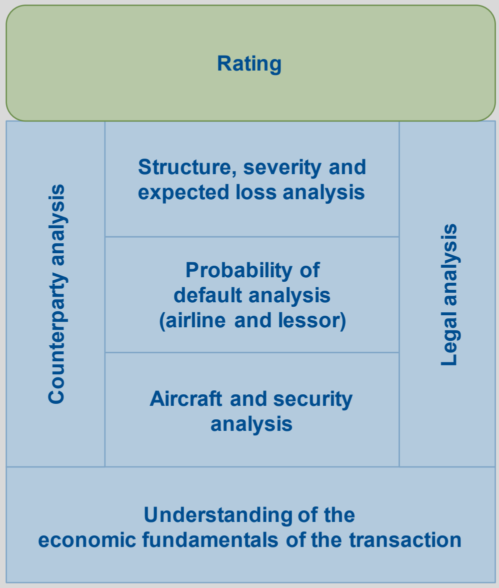
[1] Our website provides Scope's idealised EL and PD tables in Excel format, and also the document Idealised expected loss and default probability tables explained. The idealised EL tables represent a common benchmark for all secured asset classes at Scope.

The NPI-framework explains how we determine the credit protection provided by an NPI and how it can reduce the expected loss for a lender.

Supported by real data. Aircraft are individually analysed based on their specific characteristics. We derive value-stress assumptions from historical data, linking stress to aircraft characteristics. These historical trends are also applicable to future market values of new aircraft sharing similar characteristics. This allows for the consideration of new aircraft models and transaction-specific ratings with no overarching general rating caps.

Industry perspective. This methodology takes a viewpoint similar to that used by the aviation industry. It incorporates and accounts for the factors and transaction characteristics considered by the industry to impact credit risk, integrating aviation-specific features. Our approach results in credit ratings that focus on the industry specific risk areas relevant to aviation finance investors.

Credit differentiation. Our analysis relies on input assumptions which are instrument-specific. This fundamental bottom-up approach captures the risk of each aviation financing transaction without resorting to top-down generic assumptions. Our approach allows for greater differentiation between the probability of default of the contract and the expected loss to the investor resulting from the security in the aircraft, ensuring that appropriate credit is given to the underlying security.



Analytical building blocks

Lessor involvement. We reflect the involvement of lessors and technical asset managers in a transaction, examining the alignment of interests between the service provider and the investor. This is an important driver of a transaction's expected performance.

No mechanistic link to sovereign credit quality. We do not mechanistically limit the maximum rating an aviation transaction can achieve as a function of the credit quality of the country of the aircraft's operator or owner. Instead, we assess the efficacy of insolvency laws, convertibility risk, and the risk of institutional meltdown in the context of the tenor of each rated instrument. Further, we also account for the macroeconomic environment.

NPI insurer specifics. We take into account diversification effects when NPI protection is provided by a portfolio of insurers, even if the commitments are not joint and several. In our analysis, we also consider the impact of different levels of insurer credit quality across transactions, as well as different concentrations in the portfolio of insurers.

5 Overview of analytical framework

The analytical framework comprises six building blocks: i) aircraft analysis; ii) probability of default analysis; iii) structural and expected loss analysis; iv) legal analysis; v) counterparty analysis; and vi) economic fundamentals analysis. Our fundamental understanding of the transaction supports the entire analysis, while the counterparty and legal analysis overarch the analysis of credit impairment events and their severity. All analytical blocks are equally important.

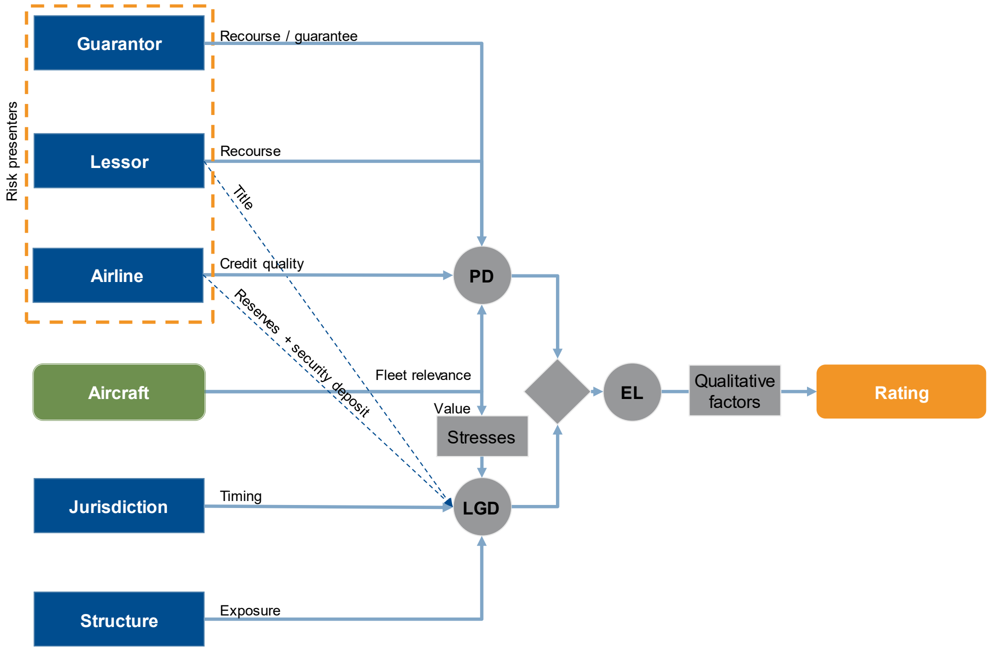
We derive assumptions on the severity of defaults by estimating the future, stressed depreciation of the aircraft's half-life value (defined in section 6.1.) and comparing this to outstanding claims against the security value. We adjust transaction recovery rates for: i) the seniority of the rated instrument; ii) specific aircraft and instrument characteristics; iii) the time value of money at the rate promised to the investor; and iv) amortisation.

We calculate the contribution to total expected loss by calculating the loss given default (LGD) multiplied by the likelihood of default in each period over the life of a transaction. Total expected loss is the sum of all period contributions. Loss given default is a function of the aircraft's stressed half-life value at time of sale, minus stressed costs and expenses. Stresses are higher when the rating-level being tested is higher (i.e. rating-level-conditional stresses).

Our analysis uses qualitative and quantitative inputs, considering the rating's sensitivity to key analytical assumptions. Quantitative analysis alone does not dictate the final rating assigned to an instrument but rather forms an input to the analytical framework presented in this methodology. The final rating incorporates qualitative and fundamental credit views on the key risks affecting the transaction's obligations.

We present in this document our analytical framework, following the natural sequence of the six analytical building blocks. Figure 1 provides a visual demonstration of the aviation finance methodology framework.

Figure 1 Aviation finance methodology visualised



Note: PD stands for probability of default; LGD stands for loss-given-default; and EL stands for expected loss.
Source: Scope Ratings.

6 Aircraft and security analysis

Our aircraft analysis involves the application of the analytical steps listed below. Each step is explained in detail in the corresponding section in the methodology and includes the following analytical steps:

- Day-one value analysis
- Application of Day-one rating-conditional stresses
- Determination of Annual depreciation assumptions
- Assessment of the impact of Aircraft repossession and remarketing: timing delays and additional costs
- Assessment of the adequacy of Maintenance reserves

The loss to the investor depends greatly on the recoverable value of the underlying aircraft, i.e. how much of the outstanding claims against the security can be recovered from the fire sale of the aircraft in the case of an obligor (typically an airline) default.

Our methodology uses aircraft-value stresses which incorporate historical data on aircraft values, information from arrangers, appraisals, and other market and macroeconomic data (e.g. on asset performance, GDP or unemployment). Most of the key inputs in our Aviation Finance methodology come from observations of market data, especially those related to aircraft value depreciations. Our depreciation and stress assumptions rely on statistical analysis performed on a dataset in 2017, which covers 26 years of historical market value data. The dataset encompasses six crisis periods, including market value depreciation observed during the Global Financial Crisis. The day-one rating conditional stress and the annual depreciation stresses presented in this methodology were found to be sufficiently conservative to account for a crisis the size of the Covid-19 pandemic at the AA-rating conditional level. We incorporate an aircraft's market value in our calculation of the day-one value to improve the rating's sensitivity to sharp market value drops, such as in a crisis scenario. The day-one value considers drops in an aircraft's market value resulting from a market downturn or issues that are specific to the aircraft model.

Our analysis of aircraft value aims to produce: i) rating-conditional value stresses which compound over time (i.e. annual depreciation assumptions); ii) an initial value stress to reflect the volatility of appraisals (i.e. the day-one value stress); and iii) other rating-conditional value stresses (e.g. remarketing and repossession time).

6.1 Day-one value analysis

The day-one value of the aircraft is usually the half-life base value as provided by appraisers. The base value is an appraiser's opinion of the underlying economic value of an aircraft in an open, unrestricted and stable environment. The half-life value assumes the aircraft is halfway between major overhauls. We typically look at three aircraft appraisal reports, one of which we commission ourselves. The half-life value used is the average between the three. If we are not provided with naked aircraft values, the day-one value applied is the half-life base value from the appraisal which we commissioned. We might use the second-best appraisal value if there is a wide divergence between the three. For particularly illiquid aircraft types such as the A380, an appraisal based on the original equipment manufacturer ('OEM') aircraft serial number could be obtained to determine a more accurate market value.

If the market value is below the base value at the time of the rating analysis – whether initial analysis or monitoring – we may apply a weighted average between the two values as the day-one value. In such cases, we calculate the day-one value as follows:

Figure 2 $\boldsymbol{Market\ value\ weight} = \mathbf{50\%} * (\mathbf{1} - \boldsymbol{MIN}\left(\mathbf{1}, \boldsymbol{MAX}\left(\mathbf{0}, \frac{\boldsymbol{market\ value - historical\ low}}{\boldsymbol{base\ value - historical\ low}}\right)\right))$

If the market value equals the historical low seen for the aircraft model, the day-one value will be calculated applying a 50% weight to the market value and a 50% weight to the base value. If the market value equals or is higher than the base value, the weight will be 0% market value and 100% base value. If the market value is between the historical low and the base value, the weight given to the market value will be linearly decreased from 49% to 1%. Figure 3 summarises how we determine the day-one value considering the base value, market value, and the historical low.

In very rare cases a 100% weight can be given to the market value. We will only do so if we identify specific issues with the aircraft model in question that will have a severe impact on the future value development of the aircraft model.

Figure 3 Determination of the day-one value

Market value vs. base value	Market value vs historical low	Market value weight
Base value <= market value	n/a	0%
Base value > market value	Market value > historical low	1% - 49% Determined by where the market value lies in relation to the base value and historical low
Base value > market value	Market value <= historical low	50%
Base value > market value	Market value <= historical low	100% weight can be given to market value in very rare cases

Source: Scope Ratings.

6.2 Day-one rating-conditional stress

We apply haircuts to the day-one value by applying a rating-conditional stress from day one. The post day-one stressed value is then subject to annual depreciation stresses, which accumulate by compounding over time.

The day-one stress is a function of the aircraft age. 0 sets out the day-one stress for aircraft aged up to 11 years. The full 20-year table can be found in Appendix III. When considering a portfolio of aircraft of different vintages, we calculate a weighted average vintage that reflects the age structure of the portfolio. Expression (1) explains how the haircut is derived for different rating-conditional stresses. Day-one stresses are made rating-conditional by applying a multiplication factor for each rating level, as demonstrated in Figure 5.

$$(1)\ Day\text{-}one\ stress(Rating\ stress, Age) = Stress\ factor(Rating\ stress) \times Day\text{-}one\ value\ standard\ deviation(Age)$$

Figure 4 Indicative table of the day-one-value standard deviation as a function of aircraft age at the analysis date

Age of aircraft (years)	1	2	3	4	5	6	7	8	9	10
Day-one-value standard deviation	4.93%	4.93%	6.98%	8.48%	10.08%	11.38%	12.23%	12.51%	12.43%	12.47%

Source: Scope Ratings.

Figure 5 Day-one rating-conditional stress factors

Rating stress	AAA	AA	A	BBB	BB	B
Stress factor	2.5	2.0	1.5	1.0	0.5	0.0

Source: Scope Ratings.

6.3 Annual depreciation assumptions

Aircraft are depreciating assets, even when properly maintained. We consider the aircraft's annual depreciation and how this impacts recovery values.

6.3.1 Base annual depreciation

Our analysis incorporates four main factors which drive the depreciation of an aircraft's market value: i) the age of the aircraft (weighted average in case of multiple aircraft); ii) the phase in the lifecycle of the specific aircraft model; iii) the body type of the aircraft; and iv) the condition of the market. All four factors are statistically significant at the P≤0.001 level. Body type reflects several characteristics, such as liquidity difference between aircraft bodies. We developed our aircraft-value methodology using more than 26 years of historical aircraft values provided by the Aircraft Value Analysis Company (AVAC).

We estimate the annual depreciation for a given aircraft using a regression analysis which incorporates the four aforementioned factors. This is reflected in the regression line shown in expression (2), where *Age* is the age of the aircraft in years, and *Age factor*, *Body component(Body)*, and *Phase component(Phase)* take the values shown in Figure 6, respectively.

$$(2)\ Annual\ depreciation(Age, Body, Phase) = 4.29\% + Age\ factor \times Age + Body\ component(Body) + Phase\ component(Phase)$$

Figure 6 Components of the annual depreciation analysis

Aircraft age	Aircraft body type	Lifecycle phase of aircraft model
Age factor: 0.23%	Regional: 0.77%	Phase-in: 1.20%
	Widebody: 1.21%	Phase-out: 1.81%
	Narrowbody: 0.00%	Phase-mature: 0.00%
	Freighter: 0.39%	Out-of-production: 4.16%

Source: Scope Ratings.

The total depreciation over periods that exceed one year will be the compounded effect of the series of annual depreciation rates. The equivalent compounded depreciation over a period of N years will be calculated as per expression (3).

$$(3)\ Compounded\ depreciation(N\ years) = 1 - \prod_{i=0}^{N}(1 - Annual\ depreciation_i)$$

6.3.2 Four key drivers of aircraft value depreciation

6.3.2.1 Aircraft age

The older an aircraft becomes, the larger the impact of age on its market value. In other words, aircraft age accelerates the rate of value loss. This relationship is evident in expression (2), which shows that annual depreciation increases 0.23pp yearly. The age factor is dynamic, whereas body type has a constant impact through an aircraft's life.

6.3.2.2 Aircraft body type

An aircraft's value also depends on aircraft efficiency and the size of the potential operator base in the case of a default. Further, aircraft specific features such as engines and differences in cost levels of maintenance work. We classify commercial aircraft into four categories, as shown in Figure 7.

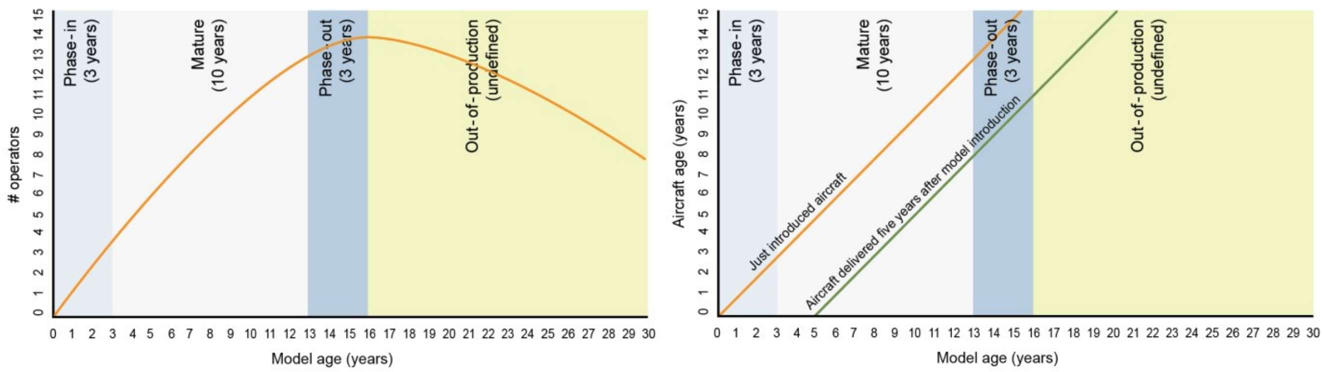
Figure 7 Aircraft body-type classification

Body type	Description
Regional aircraft	Turboprops and jets with <120 seats;
Narrowbody	Single-aisle aircraft with >120 seats;
Widebody	Double-aisle aircraft
Freighter	Cargo-only aircraft

6.3.2.3 Lifecycle phase of aircraft model

We have identified four phases in the lifecycle of any aircraft model: i) phase-in; ii) mature; iii) phase-out; and iv) out of production. An aircraft's value changes at different annual rates depending on the phase in the aircraft model's life. Figure 8 illustrates the four phases and how they relate to an aircraft's popularity in the market (presented as number of operators). An aircraft can already reach the out-of-production phase after one year if it was among the manufacturer's last units of that model. Further, an aircraft will typically migrate over its life through the different phases of the model type.

Figure 8 Illustration of the idealised phases in the lifecycle of an aircraft model: Model popularity (left), and migration through different phases for two particular aircraft



Source: Scope Ratings.

A new model's first three years in the market is referred to as the phase-in. We assume the longest period to be the mature phase, lasting up to 10 years. The model migrates into phase-out when the manufacturer announces a new aircraft model will replace it. If the aircraft is 10 years old and no replacement has been announced, the aircraft model will remain longer in the mature phase. This will be determined during our annual monitoring of the transaction. When a manufacturer has ceased production of a specific model, we deem it to have entered the out-of-production phase.

6.3.2.4 Market environment

We determine aircraft body, aircraft age and model phase for all transactions and assume that market conditions account for the remaining depreciation. The intercept of the above formula (4.29%) is the result of adding together i) the average annual aircraft depreciation across all bodies, model lifecycle phases, aircraft ages and market conditions (9.75%); and ii) a constant intercept of our regression exercise (-5.46%). We may adjust components of the annual depreciation analysis as newer data becomes available and consider a forward-looking market environment that deviates from the historical average if justified by the industry and macroeconomic analysis.

6.3.3 Stressed annual depreciation

We stress the annual depreciation rates as a function of the rating scenario being tested because transactions must be able to tolerate higher stresses for higher rating scenarios (i.e. B level being the lowest stress; AAA being the highest). The base annual depreciation assumptions correspond to our expected scenario, which we link to the B-level rating-conditional stress (these were presented in section 6.3.1). The stresses result from our analysis of AVAC data and the volatility we have observed in aircraft values during past crises.

We test the transaction's stress resistance by applying a day-one stress and a year-on-year stress, both rating-conditional. Aircraft value credited in the analysis embeds day-one and compounded annual depreciation stresses, shown in expression (4). The annual depreciation rates are applied to the aircraft value after the day-one stress.

$$(4)\ Credited\ value = Appraisal\ value \times [1 - Stressed\ day\text{-}one\ haircut] \times [1 - Compounded\ stressed\ annual\ depreciation]$$

Our rating-conditional stresses to annual depreciation rates account for aircraft value and market downturns. The stresses reflect the different volatilities of aircraft values (expressed as coefficient of variation) as a function of body type and the aircraft model phase, as portrayed in Figure 9. Additionally, we implement the rating-conditional stress via a multiplicative factor, as per Figure 10.

$$(5)\ Compounded\ stressed\ annual\ depreciation = $$

$$= 1 - \prod_{t=t_0}^{time} \left(\mathbf{1} - base\ annual\ depreciation \times (\mathbf{1} + stress\ factor \times coefficient\ of\ variation)\right)$$

Figure 9 Coefficient of variation of annual depreciation rates

	Phase-in	Mature	Phase-out	Out of production
Narrowbody	89.79%	137.68%	76.93%	58.66%
Widebody	93.33%	92.97%	59.28%	59.27%
Regional	125.14%	94.74%	79.76%	63.77%
Freighter	84.67%	128.19%	69.55%	65.79%

Source: Scope Ratings.

Figure 10 Year-on-year rating-conditional value stress

	AAA	AA	A	BBB	BB	B
Stress factor	0.5	0.4	0.3	0.2	0.1	0.0

Source: Scope Ratings.

6.4 Aircraft repossession and remarketing: timing delays and additional costs

Aircraft must be repossessed and remarketed in an event of default. The value realised from the liquidation of an aircraft must consider the aircraft's characteristics at the time of sale, not at default – see expression (6). Repossession and remarketing costs are deducted from sale proceeds as per expression (7).

$$(6)\ Time_{sale} = time_{default} + repossession\ delay + remarketing\ delay$$

$$(7)\ Proceeds\ from\ aircraft = stressed\ half\text{-}life\ value(time_{sale}) - repossession\ and\ remarketing\ costs$$

6.4.1 Repossession time

Repossession time assumptions typically range from two to six months. The country the airline is domiciled in is used to determine the repossession time.

We have analysed the regimes of different jurisdictions and derived the assumptions for five groups of countries – see Figure 11. We leverage the analysis in the Pillsbury's World Aircraft Repossession Index[2] and other public sources with our own internal expertise to size repossession delays for a given jurisdiction.

In exceptional cases, we will assume repossession times that exceed six months. Examples include extraordinary enforcement impediments such as forced grounding of aircraft or expropriation.

Figure 11 Indicative repossession time assumptions

Months	Country
2	Aruba, Australia, Belgium, Bermuda, British Virgin Islands, Canada, Curacao, Czech Republic, Denmark, Finland, France, Germany, Guernsey, Ireland, Jersey, Netherlands, New Zealand, Norway, Malta, San Marino, Singapore, Spain, Sweden, Switzerland, United Kingdom, USA
3	Austria, Bahamas, Cayman Islands, Estonia, French Polynesia, Greece, Hong Kong, Italy, Latvia, Lithuania, Mauritius, New Caledonia, Poland, Portugal, Slovakia, Slovenia,
4	Brazil, Costa Rica, Croatia, French Polynesia, Japan, Kenya, Korea, Macau, Malaysia, Panama, Philippines, Qatar, Rwanda, Taiwan, Trinidad and Tobago, United Arab Emirates
5	Angola, Argentina, Azerbaijan, Bahrain, Bangladesh, Belarus, Bolivia, Cameroon, China, Colombia, Cote D´Ivoire, Ethiopia, Georgia, Hungary, India, Indonesia, Jordan, Kazakhstan, Malaysia, Mexico, Morocco, Mozambique, Namibia, Oman, Pakistan, Papua New Guinea, Romania, Senegal, Serbia, South Africa, Sri Lanka, Tajikistan, Turkey, Uzbekistan,
6	Bulgaria, Cambodia, Chad, Dominican Republic, Ecuador, Egypt, El Salvador, Guatemala, Jordan, Kuwait, Laos, Madagascar, Moldova, Mongolia, Myanmar, Nepal, Peru, Saudi Arabia, Vietnam

Source: Scope Ratings.

6.4.2 Aircraft remarketing time

The base case remarketing assumption is six months. Remarketing delay assumptions are based on our experience as well as extensive discussions with the International Bureau of Aviation (IBA). We consider a remarketing time extended by three months when one or more of the conditions in Figure 12 are met (i.e. stresses are not accumulated if more than one condition applies). We further extend the remarketing time by one to three months when there are concerns regarding the aircraft, transaction counterparties or market environment. For instance, an Airbus A380-800 would receive another three months remarketing time due to a low potential operator base.

Figure 12 Remarketing time base case and stresses

Elements of the remarketing time assumption	Value
Base case remarketing time	**6 months**
Widebody or freighter	**+3 months added** (when one or more of the listed features are present)
More than 5 years of age	
'Phase-out' or 'Out of production' model	
Low liquidity	
Inexperienced or no asset manager	
Specific concerns over aircraft, transaction counterparties or market environment	**+1 to +3 months added**

Source: Scope Ratings.

6.4.2.1 Asset manager quality

The asset manager's quality and experience impact credit risk. We analyse the asset manager's repossession and remarketing experience and capabilities, accounting for the size of its network and track record. An asset manager is expected to have experience

2 Pillsbury Winthrop Shaw Pittman LLP; World Aircraft Repossession Index, Fourth Edition, January 2023.

in the aircraft model in question or a comparable model. We also evaluate the existence of internal resources such as technical asset management skills. Operational visits will be made if the asset manager or lessor has a large impact on the credit risk of the transaction, for example if the airline has a high probability of default and data suggests that the manager is able to reduce remarketing time significantly; or if the manager or lessor is newly established or has an unknown track record in the market.

6.4.3 Repossession and remarketing costs

The costs associated with the repossession and remarketing of an aircraft are based on IBA data and our experience and knowledge of the market. We deduct from sales proceeds the repossession and remarketing costs, which we combine and then classify as either fixed or variable. Fixed costs are the unavoidable costs directly related to the repossession and remarketing process. Variable costs are a function of the expected repossession and remarketing time. Costs depend on the aircraft's features and jurisdiction as well as conditions at the time of remarketing (Figure 13). Costs can vary largely among transactions, which we capture by applying rating-conditional multiplication factors to the costs (Figure 14). Scope will update these costs from time to time if material price changes are observed. Scope will use relevant indices such as the Producer Price Index by Commodity: Repair and Maintenance Services (Partial): Aircraft Repair and Maintenance or the Producer Price Index by Industry: Services Less Trade, Transportation and Warehousing (as published by the Federal Reserve of St. Louis).

Figure 13 Remarketing and repossession costs

Aircraft type	Fixed costs (USD)	Variable costs (USD/month)
Regional and narrowbody	**890,000**	**67,000**
Widebody	**1,390,000**	**89,000**
Freighter WB	**1,110,000**	**67,000**
Freighter NB	**670,000**	**56,000**

Source: IBA and Scope Ratings.

Figure 14 Remarketing and repossession costs: rating-conditional multipliers

Rating-conditional stress	AAA	AA	A	BBB	BB	B
Multiplier	2.0	1.8	1.6	1.4	1.2	1.0

Source: Scope Ratings.

6.5 Maintenance reserves

We apply a percentage penalty for a lack of contractual obligation to maintain reserves. The physical maintenance condition of an aircraft can range between run-out and full-life. Aircraft collateral is accounted for as having a half-life condition. We apply a penalty to simulate a maintenance-adjusted value.

Figure 15 shows the maximum rating-conditional penalties to aircraft value when inadequate maintenance reserves are in place. Figure 16 shows the penalty reduction-factors as a function of the level of effective maintenance reserves and the credit quality of the operating airline.

Figure 15 Maximum penalty for lack of maintenance reserves

Rating-conditional level	AAA	AA	A	BBB	BB	B
Maximum penalty	12.00%	10.67%	9.33%	8.00%	6.67%	0.00%

Source: Scope Ratings.

Figure 16 Penalty factor as a factor of available reserves and operator quality

Airline quality	No reserves	Partial reserves*	Full reserves
B or below	**100%**	**50%**	**0%**
BB	**100%**	**25%**	**0%**
BBB	**50%**	**0%**	**0%**
A, AA, AAA	**0%**	**0%**	**0%**

* We will assume there are no reserves when partial reserves are low.

Source: Scope Ratings

A 12% penalty for lack of reserves is applied to the value when the airline is rated BB or below for the AAA rating level; a 6% penalty for a BBB airline rating for the AAA rating level; and 4% (8% penalty x 50% partial reserves factor) for a BBB rating with a BBB rated airline and so on. No penalty applies if the airline has a credit rating of A or above.

We credit a transaction as having a full reserve if we assess that maintenance reserves are adequate and pledged in favour of the investor, or that legal remedies can ensure access to reserves in case of a default. We may request a technical opinion from a reputable provider to determine the adequacy of maintenance reserves.

Otherwise, we deem reserves to be partial if we assess maintenance reserves to be inadequate, or when reserves cannot be accessed fully in the case of a default. Nevertheless, we do not apply a penalty for lack of maintenance reserves when exposed to airlines rated A or higher because the jump to default probability of such airlines is very small, and any transition to default would likely take several years.

7 Probability of default analysis

Our probability of default analysis focuses on the aircraft finance contracts. The payments on the rated instruments are dependent on the payments on the aircraft leases as the lease payments are passed through as debt service on the acquisition loan. Default probability then depends directly on the creditworthiness of the airline operating the aircraft and/or the creditworthiness of the lessor or guarantor in the case of a direct exposure or full recourse to a lessor or guarantor (hereafter, risk presenters). The contract's probability of default may be lower than that of the operating airline if the underlying aircraft is strategically important to the airline or lessor. The annual cumulative default probabilities for two contracts with default probabilities commensurate with B and BBB credit qualities, respectively, are illustrated in Figure 19.

We analyse the liquidity strength of the transaction. If there are liquidity reserves or other liquidity enhancements available this will be treated based on the principles described in our General Structured Finance Methodology (section 2.2.1).

We analyse the contract's default probability in relation to the timely payment of the contractually agreed principal and interest payments.

The final rating might be negatively impacted if the probability of default is considered so high as to potentially result in interruptions to promised payments on the rated notes or loans. Please see our technical note on timely payment in Appendix I for more details.

7.1 Standalone credit assessment of risk presenters

We assess the creditworthiness of risk presenters – the airline and/or lessor – using different approaches depending on the relative size and materiality of the exposure to the risk presenter.

Our corporate and financial institutions rating analysts provide ratings and/or credit estimates of material risk presenters, as well as their knowledge on an airline's business model and competitive environment. We leverage on the analysis of our sovereign and public finance analysts to gain a forward-looking view on the macroeconomic conditions in which the aircraft is expected to operate.

The probability of default of the contract might be higher than that of the risk presenter if the rating or credit estimate provided by our corporate rating analysts is under review for downgrade.

The preferred approaches for assessing risk presenters' creditworthiness are shown in Figure 17. Scope ratings are used when a risk presenter's exposure is excessive, i.e. when the default of a risk presenter would increase expected loss for the investor by more than six notches. We generally do not expect exposures representing less than 25% of the total rated instrument to be excessive.

Our analysis will consider a risk presenter's public ratings from other credit rating agencies, and we will validate these with Scope credit estimates when the exposure represents over 25% of the total rated instrument. We may consider a lower creditworthiness than that suggested by the public rating if our credit estimate deviates significantly from the public rating of other credit rating agencies.

In the absence of public ratings, we will perform credit estimates on risk presenters with an exposure greater than 5%. The credit estimates will be reviewed annually for exposures greater than 5%. For not excessive and unrated risk presenters, we will apply a conservative fallback credit quality assumption of CCC as appropriate if the available information is insufficient to perform a credit estimate.

Our analysts will perform a basic credit assessment using market benchmarks for exposures below 5% of the total rated instrument.

Figure 17 Preferred methods for assessing the creditworthiness of risk presenters

	Materiality of exposure		
Exposure to risk presenter	Not excessive and publicly rated risk presenter	Not excessive and unrated risk presenter	Excessive
Exposure > 25%	Public rating, supported by point-in-time Scope credit estimate	Scope credit estimate, reviewed annually	Scope rating (public or private)
15% < exposure < 25%	Public rating		Scope rating (public or private; but generally not an expected case)
5% < exposure < 15%			
Exposure < 5%		Generic default risk assumption	

Source: Scope Ratings.

Risk presenters' creditworthiness determines the term-structure and numerical values of our default probability assumptions, as per our idealised probability of default curves.

7.2 Full recourse to lessor (adjustment for the joint default of risk presenters)

We give credit when there is full recourse to a lessor or another separate entity like a guarantor. In these cases, the default of the aviation finance contract requires the joint default of all risk presenters, because the full-recourse provider will guarantee contractual obligations if an airline default. Similarly, if the full-recourse provider defaults, all the airline's contractual obligations will remain legally valid and binding.

Our analysis reflects joint defaults by applying a probability of default for the contract that is lower than that of the strongest risk presenter. Nevertheless, we also assume a generally high correlation between the enterprise value of an airline and a lessor or guarantor with mutual commercial ties. We assume a high asset correlation of 75% between risk presenters.

Figure 18 illustrates the contract's one-year probability of default[3], reflecting the improvement due to a full recourse to a lessor or a guarantor. The probability of default is a function of the credit strength of two risk presenters (e.g. airline and lessor), one of which is stronger than the other. The assumption of a one-year probability of default is a simplification that applies to all rated instruments, regardless of their risk horizon. This simplification is justified because the rating level commensurate to the joint probability of default is only marginally sensitive to changes in the risk horizon.

In the below table the stronger in Figure 18 refers to the risk representer with the better credit quality.

Figure 18 Indicative probability of default of contract (in %) as a function of the credit strength of risk-presenters4

Stronger → Weaker ↓	A	A-	BBB+	BBB	BBB-	BB+	BB	BB-	B+	B	B-
A	0.0071										
A-	0.0095	0.0130									
BBB+	0.0132	0.0202	0.0257								
BBB	0.0172	0.0238	0.0342	0.0489							
BBB-	0.0212	0.0304	0.0467	0.0671	0.0933						
BB+	0.0307	0.0490	0.0761	0.1164	0.1753	0.3665					
BB	0.0335	0.0553	0.0867	0.1360	0.2061	0.4785	0.6290				

[3] The values in Figure 18 are the result of a Monte Carlo simulation with five million iterations and should be considered indicative.
[4] Scope idealised PD tables can be found here https://scoperatings.com/#!governance-and-policies/rating-scale

Stronger → Weaker ↓	A	A-	BBB+	BBB	BBB-	BB+	BB	BB-	B+	B	B-
BB-	0.0368	0.0596	0.0961	0.1563	0.2359	0.5802	0.7808	0.9743			
B+	0.0381	0.0659	0.1074	0.1767	0.2898	0.7473	1.0407	1.3561	1.9877		
B	0.0396	0.0684	0.1123	0.1830	0.3101	0.8197	1.1619	1.5248	2.3134	2.7096	
B-	0.0404	0.0695	0.1165	0.1967	0.3307	0.9257	1.3753	1.8474	2.9092	3.4781	4.6582
CCC	0.0404	0.0729	0.1233	0.2110	0.3647	1.1020	1.6985	2.3719	4.1272	5.1729	7.5823
CC	0.0413	0.0729	0.1240	0.2110	0.3678	1.1334	1.7545	2.5189	4.5126	5.8100	8.8760
C	0.0413	0.0729	0.1240	0.2111	0.3678	1.1406	1.7753	2.5430	4.6058	5.9414	9.2395
D	0.0413	0.0729	0.1240	0.2111	0.3678	1.1416	1.7753	2.5430	4.6058	5.9480	9.2395

Source: Scope Ratings.

Based on the joint probability of default of the two risk presenters illustrated in Figure 18, we derive a rating equivalent using our idealised probability of default table for a risk horizon of one year (see https://scoperatings.com/governance-and-policies/rating-governance/definitions-and-scales). This rating equivalent is then adjusted for the fleet relevance of the underlying aircraft. Finally, the adjusted rating equivalent is converted back to a probability of default that corresponds to the rating-equivalent over the risk horizon of the rated instrument.

7.3 Fleet relevance

We apply a probability of default which is lower by half a notch when the underlying aircraft is strategically important to the airline and the lessor, if there is full recourse to a lessor, provided the jurisdiction's laws protect operations through an insolvency process. This is because we believe the contract will not automatically default after an airline files for bankruptcy protection. The impaired airline will continue to honour the obligations under the contract to prevent an event of default and the loss of a key aircraft for its operations. This allows for a reduced probability of default of the contract in place.

We consider the potential relevance of an aircraft by accounting for specific characteristics of the fleet and the business model of the operating airline.

8 Structure, severity and expected loss analysis

We determine the sale proceeds of an aircraft, calculate outstanding debt and amortisation for each period. We factor in any credit enhancements (e.g. security deposits, subordinated tranches, liquidity facilities). We calculate the loss given default for each period, by deducting the stressed sales proceeds from the outstanding exposure, before calculating the expected loss and expected risk horizon. When analysing transactions with multiple aircraft we calculate the portfolio loss given default by comparing the total outstanding principal across all the aircraft with the net proceeds from a sale of all the aircraft. The total expected loss is benchmarked against idealised expected loss curves for the risk horizon that corresponds to the expected risk horizon.

8.1 Calculation of total expected loss of a rated instrument exposed to a single airline

We calculate the probability-weighted average loss, i.e. the expected loss, for the investor in the contract after having determined: i) the marginal probability with which the contract is expected to default on each period of the life of the transaction (see example step values in Figure 19); and ii) the severities of such potential defaults, considering the realisable value of the aircraft under rating-conditional stresses and other costs.

We also calculate the probability-weighted average of the risk horizons of all scenarios (i.e. the expected risk horizon of the rated instrument). The calculation of the expected risk horizon considers the different lives of the contract resulting from assuming a default on each of the periods within the contract's maximum maturity. This calculation includes the time and cost estimated for repossession and remarketing. Losses are defined with respect to the current par value of the exposure (i.e. the present value calculated with the promised cash flows discounted at the promised rate). The loss given default is the difference between the par value of the exposure and the present value of all principal and interest cash flows for the investor, also discounted at the promised rate of the exposure – as seen in the simplified expressions (8) and (9).

Total expected loss for the transaction is the sum of the expected loss calculated for each period.

Similarly, the default probabilities are used to weight the different risk horizons for each period, as shown in expressions (10) and (11).

Expected loss calculation

$$(8)\ \boldsymbol{EL} = \Sigma_{i=1}^{N} prob\{default_i\} \times \frac{Loss_i}{Bal_0} = \Sigma_{i=1}^{N} prob\{default_i\} \times \frac{(1-RR_i)\times Bal_i}{Bal_0}$$

$$(9)\ \boldsymbol{RR_i} = (1 - LGD_i) = \frac{(Aircraft\ proceeds - Senior\ claims - Costs) \Big/ (1+r_{promised})^{Recovery\ delay}}{Bal_i}$$

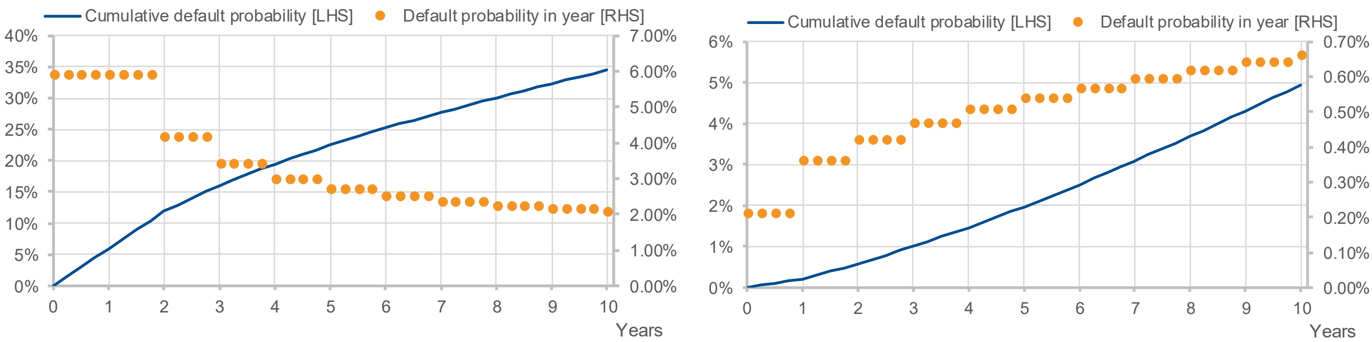
Expected risk horizon calculation

$$(10)\ \boldsymbol{Expected\ RH} = \Sigma_{i=1}^{N} prob\{default_i\} \times RH_i$$

$$(11)\ \boldsymbol{RH_i} = \frac{\Sigma_{t=1}^{T} t \times CF_{total}^{i}(t)}{\Sigma_{t=1}^{T} CF_{total}^{i}(t)}$$

$$(12)\ CF_{total}^{i}(t) = CF_{principal}^{i}(t) + CF_{interest}^{i}(t) + CF_{recovery}^{i}(t) + CF_{other}^{i}(t)$$

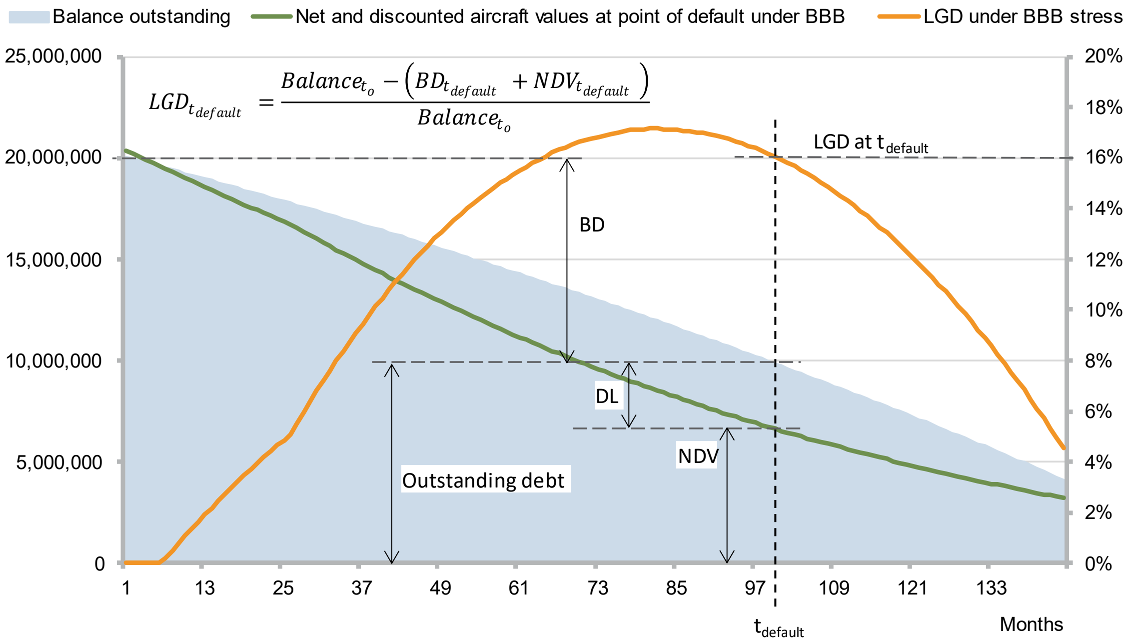
Figure 19 Annual cumulative default probabilities for B-quality (left) and BBB-quality (right) risk presenters



Note: These charts show annual periods for illustration purposes. Scope uses monthly periods in its analysis.
Source: Scope Ratings.

The discounted LGD under BBB stress at any period is represented as the difference between the outstanding balance and the net discounted value of the aircraft divided by par. In the example in Figure 20, the net discounted aircraft value (NDV) at the time of default ($t_{default}$) is EUR 6.8m. At the same time, the discounted loss (DL) at $t_{default}$ is the difference between the outstanding debt of EUR 10m and the NDV at $t_{default}$, i.e. EUR 3.2m. The LGD at $t_{default}$ is equal to the discounted loss expressed as a percentage of the initial debt balance ($Balance_{t0}$).

Figure 20 Example loss-given-default (LGD) under BBB stress



Where: LGD = loss given default; BD = balance drop; DL = discounted loss; NDV = net discounted aircraft value.
Source: Scope Ratings.

8.2 Interest rate and foreign exchange risk

In many transactions, particularly in the loan market, the debt pays a variable rate of interest, exposing the aviation finance transaction to fluctuations in the underlying index (base rate) if not hedged. Scope evaluates the transaction's hedging arrangements (e.g. lease payments linked to the base rate or interest rate swaps) and assesses the potential impact of changes in benchmark rates on the expected loss of the rated instrument, taking into account potential swap breakage costs.

Fluctuations in foreign exchange rates can affect the credit profile of a transaction, particularly if the debt is denominated in a currency other than the US dollar[5]. While aircraft lease payments are typically matched to the currency denomination of the debt, a currency mismatch may arise in a scenario where the aircraft is sold. Scope analyses the foreign currency risk of the transaction and tests its sensitivity to a depreciation of the debt currency against the US dollar. Finally, Scope typically anchors its rating case exchange rate assumption to a long-term historical average to avoid volatility resulting from short-term exchange rate fluctuations if the current spot market exchange rate reflects a historically strong dollar.

8.3 Quantitative rating-indication

We compare the expected loss and the expected risk horizon pairs to our idealised expected loss table (see https://scoperatings.com/#!governance-and-policies/rating-scale) and derives a quantitative reference or rating-indication for the rated credit exposure. The rating-indication is the highest rating level which shows maximum losses, for a risk horizon equal to the expected risk horizon, which are higher than the expected loss for the investor.

9 Aircraft non-payment insurance framework

9.1 Analytical assumptions

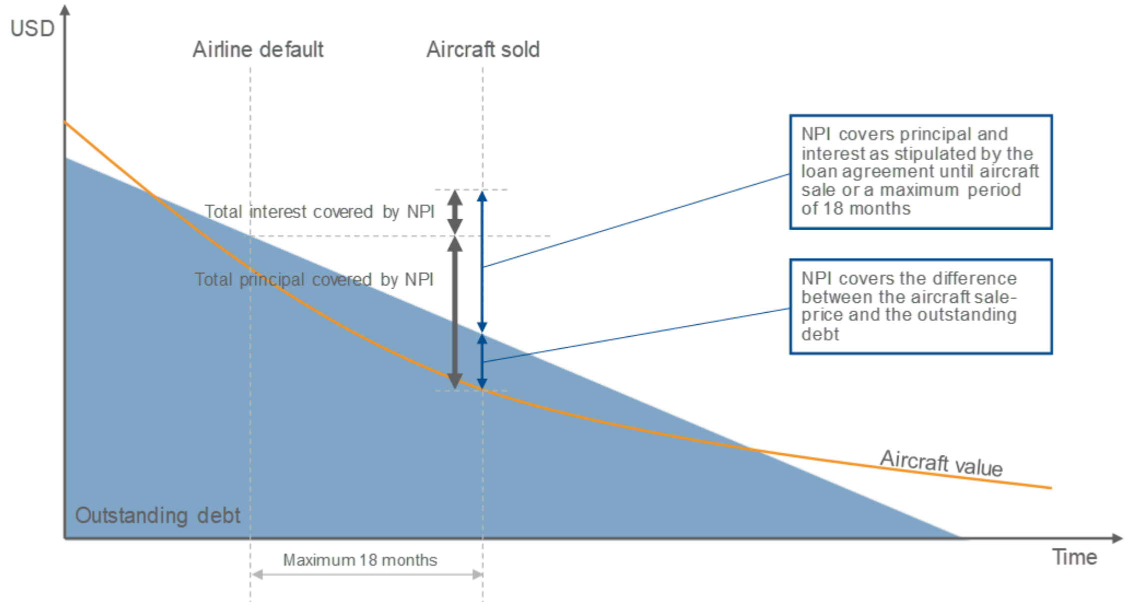
9.1.1 Insurance coverage

NPI contracts provide lenders with credit protection against an airline's default and non-payment under an aircraft-lease or loan contract in that it provides principal and interest (accrued unpaid interest) for a specified period after the airline's default. Furthermore, the insurance covers the ultimate loss after the liquidation of the aircraft (i.e. the difference between the proceeds

[5] This is because aircraft are typically traded in US dollars.

from the aircraft sale and the debt outstanding) or, if the aircraft cannot be sold within a pre-specified timeframe (coverage period) it covers the full outstanding principal amount at the end of such period. An example of an 18-month NPI is given in Figure 21 below.

Figure 21 Visual example of NPI coverage



Source: Scope Ratings.

9.1.2 Obligor

An aircraft NPI covers against the airline defaulting in a transaction secured by an aircraft. Generally, several insurers form a consortium to insure the credit risk of the transaction. NPI contracts insure collections in the case of non-payment by an aircraft-finance obligor. The obligor in the methodology is referred to as the airline; however, it can also be a lessor or other parties entering the lease and loan agreements.

9.1.3 Several basis

The NPI framework in this methodology is based on insurances provided on a several basis i.e. that an insurer is only responsible for the share of the exposure covered by its commitment, i.e. not for the shares of the other insurers in the consortium comprising the portfolio of insurers for the transaction. Defaulted insurers will not be replaced.

We also assume that an insurer cannot be replaced if it defaults during the life of the transaction, despite the fact that many NPI transactions provide for the replacement of a defaulted insurer. This is because the premium payable to the new insurer must typically be provided by the policyholder and replacing the insurer is not a hard requirement. Such structures leave the transaction exposed to the risk of non-replacement, which is the scenario considered in our analysis. We will adjust our framework accordingly if we can be certain that a defaulted insurer will be replaced over the life of a given NPI transaction.

9.1.4 Insurers' probability of default strength

We assume that an insurer's credit rating can be used to derive the term structure of defaults expected for the insurer over the life of the transaction. We consider public ratings from regulated and supervised CRAs in our analysis, which we may adjust in case we deem necessary. Those ratings are mapped to a Scope probability of default (PD) strength. See section 9.2.2.

9.1.5 Severity of insurers' default

This analytical framework makes the conservative assumption that any claim on a defaulted insurer will have a zero recovery rate under all rating-conditional scenarios.

9.1.6 Correlation of insurers' default

We assume a pairwise correlation of insurer defaults of 25%. We may stress this correlation assumption if the insurers in the consortium are related to each other.

9.1.7 Contractual Provisions

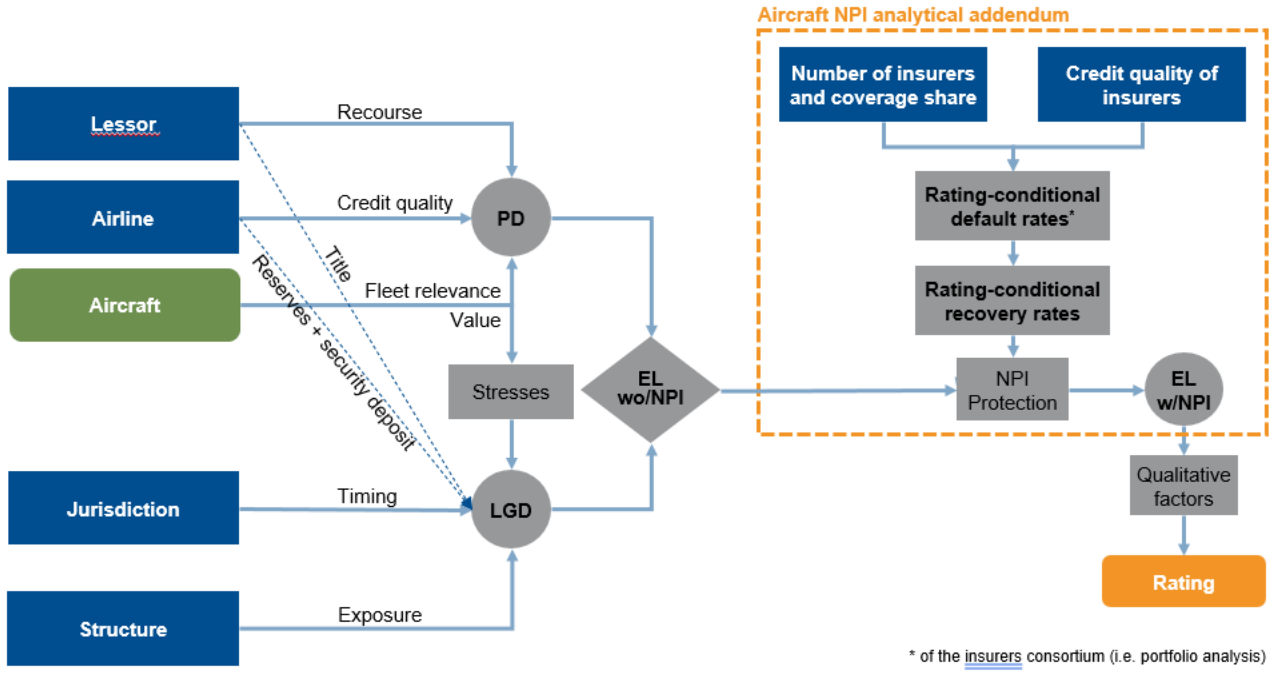
We expect the obligations to be irrevocable, as well as legal, valid, binding and enforceable. We assume that there is no conditionality of the protection with regards to timing delays of the payment from the insurance company, or scenarios where the insurance company can put a defense to not pay.

9.2 Analytical framework

The analysis of NPI transactions follows the aviation finance methodology. The main difference is that in an NPI transaction, the severity of an airline's default and the probability of default are reduced by the protection provided by the insurance consortium.

Figure 22 illustrates how the NPI analytical framework fits into the broader framework for analysing aviation finance transactions. The orange outline defines the elements covered in this chapter.

Figure 22 NPI analytical framework visualised in the context of Scope's aviation-finance methodology



Source: Scope Ratings.

NPI protection reduces the severity of an airline default. This is modelled by calculating a loss given default for an insurer, obtained as the assumed default rate in the portfolio of insurers for the period under analysis. The share of the portfolio of insurers that is not performing represents the portion of the outstanding claim before NPI that will not be recovered and will eventually be lost in that period. The sum of the probability-weighted losses after NPI for each period in the life of the transaction is the total expected loss for the NPI transaction.

In this analysis, we apply rating-conditional stresses in which the insurer-portfolio default rates increase along with the rating level tested.

Consequently, the NPI protection under each rating-conditional scenario will have a recovery rate for a theoretical claim outstanding after the aircraft's sale, or at the end of the coverage period, that is a function of: i) the number of insurers; ii) the share of each insurer in the consortium; iii) the correlation of insurer defaults; and iv) the time from the date of the analysis to the point at which the insurance claim is expected.

9.2.1 Default rate of the portfolio of insurers

We determine the share of the consortium assumed to be defaulted at a certain point in the transaction's life by running a Monte Carlo simulation on the portfolio of insurers applying Scope's portfolio model (Scope PM)[6]. The simulation produces the non-parametric probability distributions of the default rate of the insurer portfolio for every period in the transaction's life.

The default rate assumed for the portfolio of insurers equals the share of the outstanding claim after the sale of the aircraft. We assume zero recovery on the claims to defaulted insurers (i.e. 100% severity upon insurer default). NPIs are generally on a several basis, meaning that each insurer is only responsible for its share. Insurance coverage is lost for the share of defaulted insurers.

The expected transaction severity is equal to the mean of the distribution ($E\{LGD\} = \mu_{DR}$). We use the expected default rate as the base-case assumption for the B rating-conditional stress. A higher default rate assumption is used for higher rating-conditional levels (see section 9.2.3).

The share of the portfolio of insurers that is defaulted increases with the risk horizon, so the probability that NPI protection is not complete are higher for the final periods in the life of a transaction.

The higher the number of insurers in the consortium, the lower the severity if an insurer defaults. A larger number of insurers increases the effective credit enhancement provided by the NPI protection.

9.2.2 Probability of default strength of insurers in the consortium

In order to run the portfolio simulation, we assign a PD strength assumption to each of the insurers in the consortium. Our PD strengths represent assumptions about the frequency and time term-structure of defaults, linked to our idealised probability of default tables.

We assign PD strengths by mapping the public ratings available from other regulated and supervised credit rating agencies ('CRAs') to the different insurers' parts of the portfolio. Appendix IV provides our mapping assumptions, which are based on the rating correspondences implicit in the regulatory mapping of ratings to credit quality steps.

If an insurer is only rated by one credit rating agency and its share in the consortium is 50% or more, we assign a PD strength which is one notch lower than the strength that would directly result from the mapping. This is performed to account for potential individual exposures that may be statistical outliers in a broader rating mapping exercise[7]. In the case of split ratings of three or more notches, we would consider deviating from the strict average. The credit rating agencies used for the mapping are listed in Appendix IV.

Figure 23 PD strength assumption for the modelling of insurer defaults during the Monte Carlo simulation

Insurer concentration in insurer pool	Only one rating	Two or more ratings
Less than 50%	**Mapped PD strength**	**Average of mapped PD strengths**
50% or more	**Mapped PD strength notched down by 1 notch**	**Average of mapped PD strengths**

Source: Scope Ratings.

9.2.3 Rating-conditional stress

We assume that the scenarios that would result in the highest aircraft-value loss will also correspond to the scenarios where the insurers will have the highest probability of default. Therefore, this methodology implements a framework where the severity from defaulted insurers is rating-level conditional as per expression Figure 24: the higher the rating level, the higher the stress applied. We consider the expected default rate for the B rating case (i.e. no stress on the mean as shown in expression Figure 25) and a default rate equal to the mean plus two standard deviations for the AAA rating case (expression Figure 26). The default rate assumption for the other rating categories from BB to AA is interpolated linearly at 20% increments.

[6] Please find a list of Scope's models **here.**
[7] This is because the mapping is generally based on a large rating universe, but is applied here to single / small number of exposures.

Figure 24 Expression 1

$$\boldsymbol{LGD^{NPI}_{rating}(i) = DR^{NPI}_{rating}(i) = \mu_{DR(i)} + 2 \times w_{rating} \times \sigma_{DR(i)}}$$

where w_{rating} takes values 0%, 20%, 40%, 60%, 80% or 100% when rating is B, BB, BBB, A, AA or AAA, respectively.

Figure 25 Expression 2

$$\boldsymbol{LGD^{NPI}_{B}(i) = DR^{NPI}_{B}(i) = \mu_{DR(i)}}$$

Figure 26 Expression 3

$$\boldsymbol{LGD^{NPI}_{AAA}(i) = DR^{NPI}_{AAA}(i) = \mu_{DR(i)} + 2 \times \sigma_{DR(i)}}$$

9.2.4 Expected loss calculation

We calculate the probability-weighted average loss for the investor after NPI protection by overlaying the severity factor from NPI to the calculations as described in our aviation methodology.

The analysis is rating-level conditional. This means that the expected loss realised by an instrument must be commensurate with the rating level being tested. If it is not, we will consider the instrument to have failed the rating test and assign a lower rating. We benchmark the expected loss and the risk horizon against our idealised expected loss table to determine whether the losses exceed the maximum tolerable loss for the rating level being tested[8].

Figure 27 $\boldsymbol{EL_{rating} = \sum_{i=1}^{n}\left[PD(i) \times LGD^{AF}_{rating}(i)\right] \times LGD^{NPI}_{rating}(i)}$

Figure 28 $\boldsymbol{LGD^{NPI}_{rating}(i) = DR^{NPI}_{rating}(i)}$

Where:

$i = \text{Period in the life of the transaction}$

$PD(i) = \text{Probability of default of the aircraft finance contract for period (i)}$

$LGD^{AF}_{rating}(i) = \text{Rating conditional loss given default under the AF methodology for period (i)} = max\left(0{,}1 - \frac{ACv_{rating}(i + \Delta t)}{Debt(i)}\right)$

$ACv_{rating}(i + \Delta t) = \text{Aircraft value at time of sale (i. e. period i plus reposession and remarketing times)}$

$Debt(i) = \text{Outstanding debt at time of default}$

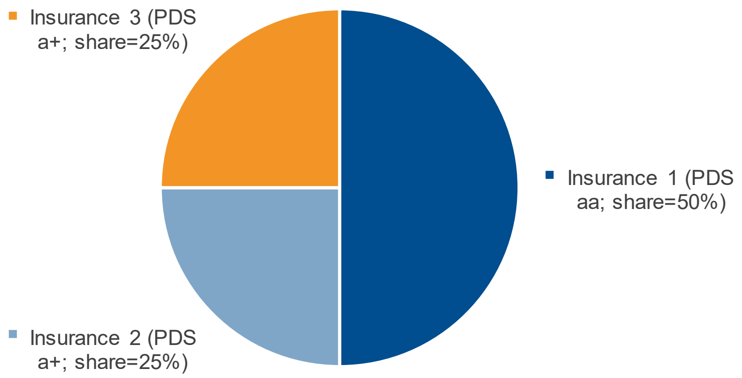
$LGD^{NPI}_{rating}(i) = \text{Rating conditional loss given default of insurers for period (i)}$

$DR^{NPI}_{rating}(i) = \text{Share of the portfolio of insurers assumed to be in default in period (i) under rating stress level } rating$

Figure 29 presents an example of a typical insurer portfolio, in which the consortium comprises three insurers with shares of 50%, 25% and 25%, respectively. The non-parametric default rate probability distribution is discrete and can logically only take any of the following values: 0%, 25%, 50%, 75% or 100%, depending on which insurers default. If only insurer 2 defaults in the time to period (i), the default rate of the portfolio would be 25% and 75% of the protection provided by NPI would still be available. This is equivalent to a severity of 25% and a recovery rate of 75%.

[8] The Scope Idealised Expected Loss Table can be found in the Ratings Definitions section of Scope's website www.scoperatings.com.

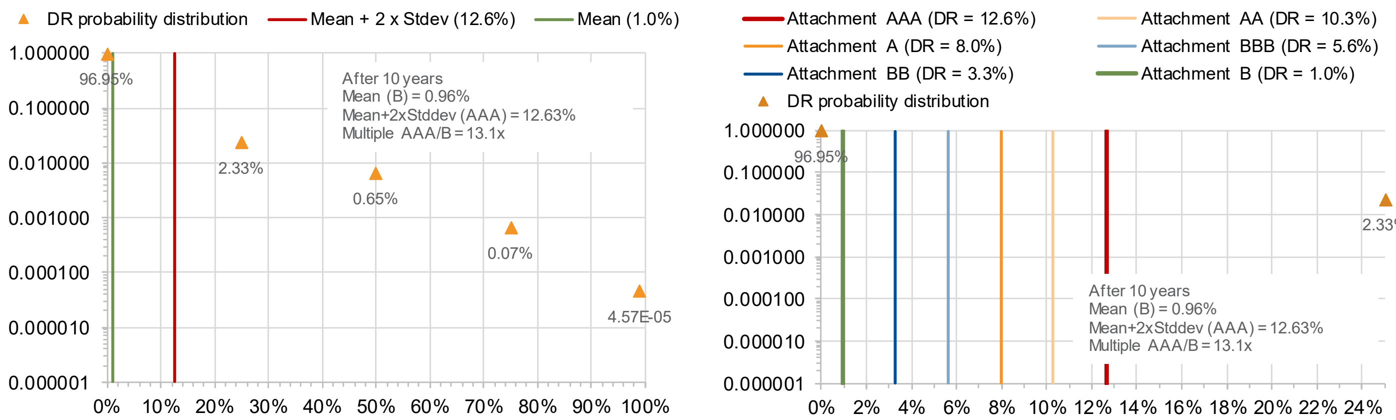
Figure 29 Example of insurer portfolio composition



Source: Scope Ratings.

Figure 30 shows one of the resulting non-parametric distributions obtained by running the Monte Carlo simulation for period *i*=10 years. Figure 30 (right) also shows the different rating-conditional default rate assumptions we use to determine the severity after NPI protection.

Figure 30 Example of non-parametric distribution of insurer portfolio default rates after 10 years of exposure



Note: The X axis represents the default rates of the portfolio of insurers. The Y axis represents the probability in a logarithmic scale.
Source: Scope Ratings.

10 Rating sensitivity

Our aviation finance rating action releases provide the ratings' stability with respect to the analytical assumptions that influence our calculation of losses for investors. The sensitivity analysis illustrates how heavily the ratings depend on our analytical assumptions. Sensitivity scenarios should not be interpreted as likely or expected scenarios.

Figure 31 shows the typical sensitivity scenarios we report as part of the rating analysis. We could decide to lower the final rating assigned to an aviation finance exposure in order to increase a rating's stability in cases where we see excessive sensitivity to any key analytical assumption compromises an adequate level of stability.

Figure 31 Typical sensitivity tests considered during the aviation finance rating analysis

Analytical assumptions tested	Shifts considered
Risk-presenter sensitivity	One category shift in the quality of the stronger risk presenter
Remarketing time sensitivity	Remarketing time increased by 12 months
Rating stress sensitivity	25% increase in day-one and year-on-year stresses
Insurance credit quality sensitivity (for NPI transactions only)	One category downgrade in the quality of all insurers

Source: Scope Ratings.

11 Legal and structural analysis

11.1 Information expected for the rating analysis

We perform our credit analysis by working with documentation that is standard to aircraft finance and NPI transactions. Figure 32 and Figure 33 detail the typical documentation and data needed for our analysis, both upon and after financial closing and during rating monitoring. We are flexible with respect to the elements and format of information used to produce a rating (i.e. we do not impose proprietary templates).

We assess the adequacy and completeness of information used in the rating process. We will explain any limitation observed in the information and may request more detail when documentation proves insufficient to rate a transaction.

Figure 32 Typical financial-closing documentation

Information expected for the initial rating analysis upon financial closing
Information memorandum
Financial model (if available)
Lease agreement
Servicer/asset manager agreement
Financial agreements (e.g. loan agreement, bond indenture, intercreditor agreement, trust deeds, security documentation, direct agreements, hedging documentation, insurance)
Financial and audit reports of material contractual parties
Corporate approvals and documents (e.g. articles of association, shareholder list, register extracts, corporate resolutions, representations and warranties)
Due diligence reports and expert opinions (e.g. technical, legal, insurance, tax, market)
Internal credit application (if available)
Internal rating assessment documentation (if available)
Lease- and sub-lease agreements
Security package documentation (e.g. Cape Town Treaty registration, mortgage agreements)
Insurance policy and details of the insurer(s) (for NPI analysis addendum)

Source: Scope Ratings.

Figure 33 Typical post-financial-closing documentation

Information expected for the initial rating analysis after financial closing and during monitoring
(Information elements listed under Figure 32
Material variations since financial closing
Latest investor or asset manager reporting
Latest financial model (if available)
Filed financial and audit reports (if available)
Covenant compliance certificates (if available)
Latest internal credit review (if available)
Latest internal rating assessment documentation (if available)
Updated aircraft appraisals

Source: Scope Ratings.

We judge the plausibility of information received for the rating process, even when sources are considered reliable and accurate. We might need additional information or clarification when the information conflicts with our understanding. These 'sanity checks' do not, however, constitute an audit nor comprehensively verify the reliability and accuracy of the information and data which we use for our rating analysis.

We believe the reliability of information increases with the degree of the arranger's alignment of interests, or the independence, experience and financial strength of parties providing the information. For example, independent legal and tax opinions generally support our legal and tax assumptions, whereas representations by an affected party would not be deemed robust.

We also use conference calls and operational review visits to gain a better understanding of the transaction's fundamentals and to get further insight into the information received.

11.2 Contract analysis

We will look for the standard wording expected in aviation finance contracts in order to identify potential weaknesses or strengths of the transaction being analysed. Special attention will be paid to the following topics:

- events of default of the lease and loan agreement;
- maintenance reserves and security deposits if applicable;
- security packages in place (Cape Town filings, mortgages and pledges);
- interest-related characteristics;
- warranties and covenants;
- insurance policy;
- sublease contract wording; and
- engine pooling.

11.2.1 Non-payment insurance policy analysis

In NPI transactions we analyse the insurance policy with regard to covenants and other elements that could exempt the insurers from their obligations. In case policies give rise to such exemptions we would expect to receive legal opinions to provide further clarity.

11.2.2 Subleasing

If the operating aircraft is subleased, or if subleasing is permitted under the terms of the head lease, we analyse the terms of the sublease to understand whether they have an impact on our legal and structural assessment of the transaction or the assessment of the other risk factors (e.g. repossession time). We expect the following legal aspects to be covered in the sublease agreement: 1) the requirement for the sublease to be subordinate to the head lease, i.e. if the lessee defaults under the head lease, the lessor may terminate the sublease and repossess the aircraft. We also expect the head lessee to continue to pay lease rentals and perform other obligations under the head lease in the event of the sublessee's default; 2) recognition of the lessor's interest as owner and lessor of the aircraft in all circumstances; 3) the lessor's right of repossession and the right to perfection or recognition of a lender's security interest; 4) we expect the aircraft to remain registered in the country of the head lessee; 5) a general requirement that the sublease contain provisions relating to matters such as maintenance, operation, insurance, etc. on the same or similar terms as the head lease.

If these principles are not met and the sublease exposes the transaction to addition risk, we may consider making an analytical adjustment to the repossession time risk factor (section 6.4.1) beyond the indicative period assumptions shown in Figure 11. For example, we may include additional repossession time if the aircraft could be re-registered in a new country with weaker repossession rights than under the law governing the head lease, or if the list of eligible sublessees includes airlines with a weaker credit quality than the head lessees and/or airlines with less experience than the head lessee. We may also make an analytical adjustment to the transaction rating to reflect the weaker legal and structural assessment in cases of weak security provisions or compromised contractual structure.

11.2.3 Pooling of aircraft engines

If the lease allows for an engine exchange or pooling arrangement, we will analyse the lease to ensure that: 1) there is no transfer of title to the engine with full security rights, 2) pooling is permitted only if no event of default by the lessee has occurred and is continuing, and 3) the lessee remains fully responsible to the lessor for the performance of all obligations relating to such engines. If these principles are not met and the pooling arrangement exposes the transaction to additional risk, we may consider making an analytical adjustment to the repossession risk factor (section 6.4.1) beyond the indicative period assumptions shown in Figure 11. For example, we may include additional repossession time if the engine is located in the new jurisdiction or the track record of the new counterparty is uncertain. As the engine represents a significant portion of the total aircraft value, in exceptional adverse circumstances we may also make an analytical adjustment to the aircraft value itself or conclude the negative assessment of legal and structural risk, which may affect the final rating.

11.2.4 Insurance provisions

We may not give credit to available insurance contracts if their validity is not clear from the transaction documents received.

11.3 Financial structure analysis

We evaluate the structural characteristics of the rated transaction in order to determine the effective hierarchy (i.e. seniority) of the rated exposure. As part of this step, we also analyse the characteristics of the issuer, the structural aspects of the rated instrument and other transaction-specific risk drivers not captured in the previous steps of the analysis. Key structural elements which we review in relation to an aircraft finance transaction include: i) structural features; ii) systemic risks; and iii) other transaction- or sector-specific risks.

Structural features can improve or weaken the transaction's credit performance. Key structural features generally include: i) the priorities of interest and principal payments, both pre- and post-enforcement; ii) payment frequencies; iii) enhancement features such as excess spread, cash reserves or liquidity buffers; and iv) coverage of the issuer's ordinary and extraordinary expenses.

We expect the transaction documents we review to set forth such structural elements in a legal, valid, binding and enforceable manner. We typically derive most structural parameters relevant to lease rates and expense assumptions from contractual terms governing the structure. We rely on expert qualitative assessments when certain parameters are not contractually specified or include provisions for variable components.

11.4 Legal and tax analysis

We consider the legal framework to assess the legal integrity of the structure and identify any legal issues or weaknesses that could affect the transaction's performance. We consider tax aspects associated with the collateral that may affect cash flows within the transaction. To do this, Scope Ratings reviews the tax and legal opinions provided by third-party experts.

It is important when assessing the structure's integrity to evaluate the likelihood that the issuer could default for reasons unrelated to collateral or counterparty risks. Such defaults could lead to a liquidation of the collateral and expose the rated instrument to market value losses even when both the collateral and counterparty perform well.

Our review of the issuer's bankruptcy remoteness is key to the analysis. It is impossible to remove the risk of issuer bankruptcy entirely. However, the issuer is generally protected through standard securitisation features specific to the issuer's nature, as well as its activity and relationships with the transaction's parties. We evaluate the strengths of protective elements in the rated transaction. These elements include the issuer's legal nature, restrictions on its activity, ownership structure and limited liabilities. We also review the limited-recourse and non-petition provisions in the transaction contracts which prevent other contractual parties from causing the issuer to default. This analysis allows us to form an opinion on the issuer's insolvency risks.

We consider third party credit enhancement and structural enhancement especially in the form of guarantees. Credit enhancement by a guarantor is based on credit substitution. Scope therefore assesses whether the credit risk of the guaranteed transaction party can be substituted by the credit risk of the guarantor.

In some transactions, the true sale of aircraft to the issuer by the seller – which is generally the airline or manufacturer – is a key mechanism for isolating the risks of the securitised collateral. For a large majority of aviation finance transactions, we assess the legal robustness of the true sale to evaluate the risk of collateral claw-back and consolidation on the seller's balance sheet, should the seller default shortly after the collateral is sold.

Tax opinions should be clear on whether any tax liability could affect a transaction's cash flow, or on the issuer's ability to pay principal and interest on the rated instrument. We would need access to the tax analysis of the transaction to assign a rating.

We generally assess the risks related to unclear or broad definitions of the legal documentation, for example, pertaining to key transaction mechanisms such as definitions of transaction default and termination events. For details on the analysis of legal and tax risks and the consideration of third party credit enhancements (e.g. guarantees), refer to Appendix XI of our General Project Finance Rating Methodology.

11.5 Counterparty risk

We analyse counterparty risk alongside the transaction's fundamental characteristics, reflecting the credit and other risk implications of financial and operational exposures to the different counterparties. Financial counterparties include, among others, the liquidity facility provider, the account bank, or the paying agent. Operational counterparties include the asset manager or servicer (responsible for the ongoing operations and administration of the SPV, aircraft inspection, remarketing and repossession).

We assess the risk factors that refer to a counterparty's credit quality using our ratings, credit estimates, assessments of credit risk, or public ratings issued by other regulated rating agencies.

We analyse the materiality of an exposure to a counterparty, depending on how severely a counterparty failure could impact the credit performance of the rated instrument. We distinguish financial risk from operational risk and assess how well available remedies mitigate or reduce risk exposures to counterparties in the context of the project. Remedies common in aviation finance, particularly for financial counterparties, include minimum credit ratings and replacement language.

We assess the rated instrument's sensitivity to a counterparty default and quantify the impact on the rating, taking into account the counterparty's credit quality, the size of the risk exposure, as well as the exposure's duration. We may constrain the rating if there is a material, unmitigated risk exposure to a counterparty and remedies are unavailable or ineffective. Examples include potentially sizeable derivative exposures to hedge providers or large exposures to account banks such as security deposits.

We take comfort in the regulated framework governing insurance companies in NPI transactions. However, if, and only if, there is any concern (e.g. intermingling ownerships between the insurers in the consortium) about a given insurer exposure, we will analyse the counterparty risk posed by the different insurers' parts of the consortium for the NPI transaction.

For details on the counterparty assessment of financial counterparties, refer to our Counterparty Risk Methodology.

12 Consideration of environmental, social and governance factors

We recognise that environmental, social and governance (ESG) factors can affect the credit quality of risk presenters, as well as the value of an aircraft and the likelihood and severity of credit losses. The guidelines presented in this methodology incorporate ESG factors. Our aviation finance rating reports highlight where ESG factors are credit risk drivers, for the benefit of investors seeking to comply with the Principles for Responsible Investment (PRI).

Appendix II shows the ESG factors considered in aviation finance credit analysis. We provide information on the ESG issues we consider relevant to the credit risk analysis in our rating report.

13 Rating determination

We assign the final rating in a committee process where the quantitative outcome (i.e. quantitative rating-indication) is evaluated in the context of qualitative elements from the legal and structural analysis, as well as the results of sensitivity analysis.

14 Monitoring

We continuously monitor the credit risk and performance of both the collateral and key transaction counterparties.

We may adjust the rating if the instrument's performance differs materially from initial expectations. We typically monitor aviation finance transactions based on performance reports produced by the technical advisor, the asset manager, or the security trustee in the transaction, as well as on information from the originator or other transaction key agents. If the information provided by the issuer or its agent is of insufficient quality, or inappropriately delayed, we may withdraw the rating.

The ratings are monitored continuously by means of high-level checks and reviewed in detail at least once a year, or earlier if warranted by events. Since our ratings aim to provide a long-term view based on the rated instrument's maturity, a temporary dip in performance is not necessarily a reason to downgrade the rating. Similarly, we may only adjust the rating if underperformance or outperformance occurs over a sufficiently long period. We aim to avoid rating pro-cyclically and, where possible, seeks to anticipate the effect of cyclical trends in aviation finance. This translates into ratings that are forward-looking rather than reactive.

Therefore, any change in outlook for the risk presenters credit quality or an aircraft's long-term value may be considered when re-assessing its credit quality.

For instance, we continually reassess the transaction's key rating assumptions, including our expectations regarding an aircraft's stressed long-term value development in the context of the prevalent market environment, the aircraft model's future development and the risk presenter's credit quality. We may adjust our aircraft value assumption and apply the market value, or a combination of base- and market values, if we believe that the base value does not sufficiently reflect current market conditions, such as during crisis times. We may also decide to leave our stressed long-term value assumptions unchanged if deemed adequate in a stable market environment.

15 Rating model

The analytical framework described in this methodology is implemented in our proprietary model named AF EL Model (which stands for 'aviation finance expected loss model'), available in Scope Rating's list of models, published under https://scoperatings.com/governance-and-policies/rating-governance/methodologies.

Appendix I Technical note on timely payment

The rating assigned to a aircraft finance tranche may be lower than the rating derived from its expected loss and expected risk horizon if the probability of missing at least one payment, which is due and payable, is high relative to the expected loss. Consequently, Scope complements the analysis by assessing the instrument's probability of default. Please refer to Appendix IV Technical note on timely payment in our General Structured Finance Rating Methodology.

Appendix II ESG risk assessment

We implicitly capture general environmental, social and governance factors during the rating process with the sole criteria of their material impact on the credit quality of a rated transaction.

This methodology identifies the elements that are now considered to be ESG factors, and a more systematic presentation of these factors.

Our analysis of the aircraft's collateral value (as defined in sections 6.1, 6.2 and 6.3), repossession and remarketing costs (as defined in section 6.4), and the exposure to risk presenters (as described in sections 7.1 and 7.2) includes, among other things:

- Forward-looking views that consider the sustainability of the aviation transaction;
- Vulnerability risks through the analysis of technological, environmental as well as demographic transitions;
- Management quality and incentives in relation to good governance; and
- Regulatory risk, including ESG considerations.

Aviation Finance ESG risk factor guidelines

ESG factors are reflected throughout the risk factors defined in this methodology and can therefore be a driver for a rating change. We do not have a prescriptive rule for changing a rating based on ESG factors alone, but our analysis of each risk factor will determine the final rating.

This methodology takes into account environmental, social and governance factors. ESG factors are an important credit risk consideration in aviation finance. New aircraft technologies are the best defence against environmental credit risk, such as designs that lead to better fuel efficiency, lower noise levels, and advanced aerodynamics. Airline ESG risks are analysed using Scope's Corporate Methodology. Figure 34 lists material ESG factors and the corresponding section in this methodology where they are considered.

We will not always report on every ESG factor listed in this table. However, if an ESG factor has a material impact on the rating, it will be highlighted in our analysis.

Figure 34 ESG factors considered in aviation finance credit analysis

Corresponding section in AF methodology	Environmental	Social	Governance
5.1 Day-one rating-conditional stress	Aircraft age		
5.2 Annual depreciation assumptions	Aircraft age, body and phase		
5.2.3 Stressed annual depreciation	Aircraft body and phase		
5.3 Aircraft repossession and remarketing	Aircraft liquidity e.g. new technology, fuel efficiency, body and age		Political stability, legal framework and judicial independence in the airline's jurisdiction
6.1 Standalone credit assessment of risk presenter	Scope's corporate methodology section 6	Scope's corporate methodology section 6	Scope's corporate methodology section 6

Appendix III Day-one-value standard deviation by aircraft age

Age of aircraft	Day-one-value standard deviation
0	4.93%
1	4.93%
2	6.98%
3	8.48%
4	10.08%
5	11.38%
6	12.23%
7	12.51%
8	12.43%
9	12.47%
10	12.31%
11	11.92%
12	11.40%
13	10.90%
14	10.38%
15	9.71%
16	8.78%
17	8.04%
18	7.43%
19	6.74%

Appendix IV Scope PD strengths Credit Quality Steps (CQS) mapping table

In order to run the portfolio simulation, we assign a probability of default (PD) strength assumption to each of the insurers in the consortium. Our PD strengths represent assumptions about the frequency and time term-structure of defaults, linked to our idealised probability of default tables.

We established the mapping relationships based on the implicit correspondences created by the mapping of ratings to credit quality steps in the context of Directive 2009/138/EC of the European Commission.

Figure 35 shows the assumptions that we use in the context of this methodology. In case a CQS mapping has changed, we would use the then current mapping. We would categorise other regulated and supervised rating agencies not mentioned in the table according to the same principle as the CQS mapping table.

Figure 35 Current mapping of ratings to PD strengths for the purpose of running the insurer portfolio default analysis

Scope PD strength	CQS[9]	AM Best	S&P	Moody's	Fitch
PDS aaa	0		AAA	Aaa	AAA
PDS aa+	1		AA+	Aa1	AA+
PDS aa	1	A++	AA	Aa2	AA
PDS aa-	1	A+	AA-	Aa3	AA-
PDS a+	2		A+	A1	A+
PDS a	2	A	A	A2	A
PDS a-	2	A-	A-	A3	A-
PDS bbb+	3		BBB+	Baa1	BBB+
PDS bbb	3	B++	BBB	Baa2	BBB
PDS bbb-	3	B+	BBB-	Baa3	BBB-
PDS bb+	4		BB+	Ba1	BB+
PDS bb	4	B	BB	Ba2	BB
PDS bb-	4	B-	BB-	Ba3	BB-
PDS b+	5		B+	B1	B+
PDS b	5	C++	B	B2	B
PDS b-	5	C+	B-	B3	B-

Source: Scope Ratings.

[9] Source: Commission Implementing Regulation (EU) 2021/2006 of 16 November 2021

Appendix V Step-by-step example of the application of this methodology

This appendix provides a complete example to illustrate the application of the analytical framework in this methodology. The example is based on the hypothetical rating of a senior secured debt tranche of a standard narrowbody aircraft on lease to a Spanish airline. The example illustrates the features of this methodology and demonstrates our analytical insight. In this example, we assume that we want to test whether the transaction passes a BBB rating level and, consequently, we determine all stresses under BBB conditionality.

The Section column contains hyperlinks to the corresponding section of this methodology.

Figure 36 Step 1 – Laying out transaction data and specific factors

Assessment	Details	Section
Aircraft	**A standard narrowbody aircraft (2015 vintage) aged three years at day one of the transaction** – at day one the aircraft model is in a phase-out phase as a newer model is expected to be introduced on the market shortly. The aircraft has fleet relevance in the airline's fleet. No maintenance reserves are being paid. The base value of the aircraft is USD 28.74m and the market value is USD 30m.	
Day-one value	We calculate the day-one value as per Figure 3. As the market value is above the base value, 0% weight is given to the market value. The day-one value is therefore USD 28.74m.	6.1
Airline	**Spanish airline rated privately at B+ by Scope.**	
Lessor	**Full recourse to a lessor** – the lessor is rated privately at BB- by Scope. The lessor also acts as the asset manager and is considered by us to be an experienced asset manager due to its track record.	
Rated tranche	**Senior secured** – the initial loan balance is EUR 20m. The loan-to-value using the half-life base value is 70%. The transaction tenor is 12 years. Over the tenor the tranche amortises to a balloon of USD 4m. The investor receives interest at a fixed rate of 4%.	

Figure 37 Step 2 – Determining aircraft recoverable value

Assessment	Details	Section
Day-one stress	**We start by determining the day-one aircraft value stress** – we test a BBB rating-conditional scenario for aircraft that are three years old. $$\begin{aligned}&\text{Day-one stress}(BBB, 3\ years) = \\ &= \text{Day-one stress factor}(BBB) \\ &\qquad \times \text{Day-one value standard deviation}\ (3\ years) = \\ &= 1.0 \times 8.48\% = 8.48\%\end{aligned}$$ The BBB rating-conditional day-one stress is then applied to the day-one value of USD 28.74m to find the day-one stressed value under BBB conditionality. $$\begin{aligned}&\text{Day-one stressed value}(BBB) \\ &\qquad = Day \\ &\qquad - one\ value \\ &\qquad \times (1 - \text{Day-one stress factor}(BBB, 3\ years)) = \\ &= USD\ 28.74m \times (1 - 8.48\%) = USD\ 26.30m\end{aligned}$$ The aircraft value after this first stress becomes the starting point for the next steps in the example analysis.	6.2

Assessment	Details	Section
Base annual depreciation rates	**We determine the annual depreciation rates based on the aircraft's age, body and phase.** First, we calculate the depreciation in year one of the transaction: $Annual\ depreciation(3\ years, narrowbody, phase\text{-}out)^1 =$ $= 4.29\% + Age\ factor \times Age(3\ years) + Body\ component(narrowbody) + Phase\ component(phase\text{-}out)$ $= 4.29\% + 0.23\% \times 3 + 0.00\% + 1.81\% =$ $= 6.79\%$ To highlight the dynamic element of age and phase, we provide the depreciation for year five below. Here the aircraft has migrated into the out-of-production phase and is now eight years old: $Annual\ depreciation(8\ years, narrowbody, out\text{-}of\text{-}production)^5 =$ $= 4.29\% + Age\ factor \times Age(8\ years) + Body\ component(narrowbody) + Phase\ component(out\text{-}of\text{-}production) =$ $= 4.29\% + 0.23\% \times 8 + 0.00\% + 4.16\% =$ $= 10.29\%$	6.3.1
Stressed annual depreciation rates	**We further apply a rating-conditional year-on-year stress** – year-on-year annual rating-conditional stresses are applied to the half-life values after deducting the day-one stress. The stresses for the BBB rating-conditional level for year one are calculated below. First, we calculate the annual stress for year one. $Compounded\ stressed\ annual\ depreciation\ (narrowbody, phase\text{-}out) =$ $= 1 - \prod_{t=t_0}^{time}(1 - base\ annual\ depreciation \times (1 + stress\ factor(BBB) \times coefficient\ of\ variation(narrowbody, phase\text{-}out))) =$ $= 1 - (1 - 6.79\% \times (1 + 0.2 \times 76.93\%)) =$ $= 7.83\%$ The year-one annual stress is applied to each month of year one, referred to as one period. The monthly (i.e. period-on-period) stress is calculated as shown below. $Period\text{-}on\text{-}period\ compounded\ stress(year1)$ $= 1 - (1 - Compounded\ stressed\ annual\ depreciation\ (narrowbody, phase\text{-}out))^{\frac{1}{number\ of\ periods\ in\ year\ 1}} =$ $= 1 - (1 - 7.83\%)^{\frac{1}{12}} =$ $= 0.68\%$	6.3.3
Stressed aircraft values	The stressed aircraft value in each period results from the application of the day-one stress to the aircraft's half-life value, and then subsequently applying the series of stressed depreciation rates. The starting stressed value is USD 26.3m (day-one stressed value under BBB conditionality). $Stressed\ value_1 = Day\text{-}one\ stressed\ val.(BBB) \times (1 - period\text{-}on\text{-}period\ compounded\ stress\ (year\ 1)) =$ $= USD\ 26.3 \times (1 - 0.68\%)$ $= USD\ 26.12$ This is repeated for each year and period of the transaction.	

| Assessment | Details | Section |

Repossession and remarketing delay	**We determine the value after applying a repossession and remarketing delay** – the realisable value from the aircraft results from the value of the aircraft at the moment when it is sold, not the moment when the contract defaults. This is after the time needed for repossession and remarketing, following the moment of default. Consequently, aircraft values are shifted by the repossession and remarketing delays. $Stressed\ value_1 = USD\ 26.12$ Repossession delay (Spain) = 2 months Base remarketing delay (base case) = 6 months Remarketing delay stress for 'Phase-out' model = 3 months Total repossession and remarketing delay = 11 months $Time_{sale}$ = $Time_{default}(period_1)$ + Repossession delay (2 months) + Remarketing delay (9 months) = $= period_{14}$ We then look up the BBB stressed half-life value in $period_{14}$ $Realised\ aircraft\ value_1 = Stressed\ value_{14} = USD\ 24.24$ The value accounted for is the value at time of sale. The value at time of sale is the value at the time of default shifted by the repossession and remarketing delay, for this example 11 months.	6.4
Repossession and remarketing	**Deducting repossession and remarketing costs** – the costs are deducted from the shifted aircraft value obtained in the previous step. The level of repossession and remarketing costs are based on the aircraft body. Shifted aircraft value = USD 24.24m. $Theoretical\ proceeds\ from\ aircraft =$ $= Shifted\ aircraft\ value - ((fixed\ costs + (reposession\ and\ remarketing\ time \times monthly\ costs)) \times rating\ conditonal\ stress\ factor(BBB) =$ $= USD\ 24.24 - \left((USD\ 0.89 + (11 \times USD\ 0.067)) \times 1.4\right) =$ $= USD\ 21.96$	6.4.3
Penalty for lack of maintenance reserves	**Applying maintenance reserves penalty** – to find the recoverable value the maintenance reserves (MR) penalty is applied. The airline is rated B- therefore a 100% penalty factor is applied. The full penalty is 8% for the BBB rating conditional level. $Theoretical\ proceeds\ from\ aircraft = USD\ 21.96$ $Recoverable\ aircraft\ value = Proceeds\ from\ aircraft \times (1 - MR\ penalty\ (BBB) \times (penalty\ factor))$ $= USD\ 21.96 \times (1 - 8\% \times (100\%)) =$ $= USD\ 20.20$ The graph below shows the value of the BBB stressed aircraft including the day-one stress and the year-on-year compounded stress. The blue line represents the net aircraft value accounted for. It is the BBB stressed value shifted by the repossession and remarketing delay and penalised by deducting 8% from	6.5

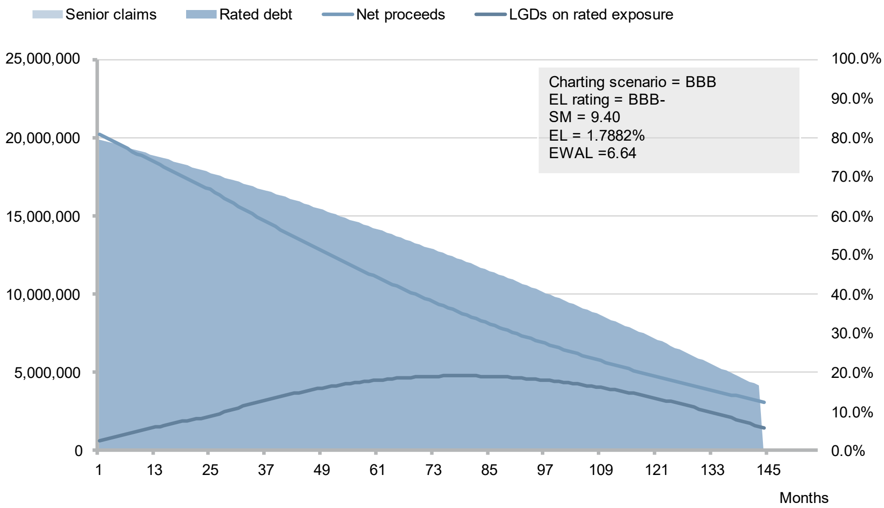
	the value for a lack of maintenance reserves. The loss given default is the difference between the net aircraft value and the outstanding claim at the time of default. 	

Figure 38 Step 3 – Determining contract probability of default

Assessment	Details	Section
Airline probability of default	**100% exposure to the airline** – as this is a single aircraft transaction and not a portfolio we have full exposure to the airline. Our corporate team will produce a private or public rating on the airline. For this example, the airline credit rating is B+.	7.1
Lessor probability of default	**Full recourse to lessor** – we calculate the joint default probability as there is full recourse to the lessor. In this example we assume the lessor is rated BB- by Scope. The joint default between the airline and lessor is BB.	7.2
Fleet relevance	**The aircraft has fleet relevance** – therefore we add a 0.5 notch to the contract's default probability. The resulting contract default probability used for the transaction is commensurate to a BB+.	7.3

Figure 39 Step 4 – Expected loss calculation

Assessment	Details	Section
Weighted expected loss for each period	**The next step is to calculate the weighted expected loss for each period of the transaction** – the recovery rate for each period, accounting for the time value of money[10], is calculated. The recovery rate is 1 minus loss given default. In our example, the recovery rates for the first 12 periods are listed in the table below. The probability of default for the period is multiplied by 1 minus recovery rate. This produces the weighted expected loss for each period.	8
Expected risk horizon	The default probabilities are used to weight the different risk horizons obtained when defaults occur on each period. The risk horizon is computed with all cash flows paid to the rated instrument. The probability-weighted average risk horizon is 6.64 years for the BBB rating-conditional level.	8.1
Total expected loss	The losses obtained assuming a default on each period are then weighted by the probability of a default on the corresponding period to find the contributions to total (expected) loss. The expected loss is the sum of all contributions and is equal to 1.79%.	8

Period (month)	Recovery rate	BB+ marginal probability of default (year 1)	Weighted expected loss for the period
1	97.47%	0.095174%	0.0024%
2	97.14%	0.095174%	0.0027%
3	96.83%	0.095174%	0.0030%
4	96.52%	0.095174%	0.0033%
5	96.22%	0.095174%	0.0036%
6	95.93%	0.095174%	0.0039%
7	95.64%	0.095174%	0.0041%
8	95.36%	0.095174%	0.0044%
9	95.09%	0.095174%	0.0047%
10	94.82%	0.095174%	0.0049%
11	94.56%	0.095174%	0.0052%
12	94.30%	0.095174%	0.0054%
…	…	…	…

Figure 40 Step: 5 – Rating determination

Assessment	Details	Section
Quantitative rating outcome	The total expected loss and the expected risk horizon of the transaction is benchmarked against our idealised expected loss curves and the corresponding rating level is found: **(1.79%, 6.64years) → BBB-** This is the quantitative rating outcome of the analysis.	8
Qualitative considerations	**The legal and structural contracts contain all expected wordings** – no legal, tax or structural issues arise from the qualitative analysis. Legal and tax opinions confirmed the transfer of the title of the aircraft and that the transaction was reasonably protected against tax liabilities. All aircraft related contracts contain expected wording for a transaction of this type.	8
Rating determination	**Final rating, BBB-** – the qualitative analysis supports the quantitative output and the final rating is BBB-.	8.1

[10] The recovery rates consider the time value of money by discounting the net proceeds over 13 months in order to capture the repossession and remarketing periods.

Scope Ratings GmbH

Headquarters Berlin

Lennéstraße 5
D-10785 Berlin

Phone +49 30 27891 0

Frankfurt am Main

Neue Mainzer Straße 66-68
D-60311 Frankfurt am Main

Phone +49 69 66 77 389 0

Paris

10 avenue de Messine
FR-75008 Paris

Phone +33 6 6289 3512

Oslo

Karenslyst allé 53
N-0279 Oslo

Phone +47 21 09 38 35

Madrid

Paseo de la Castellana 141
E-28046 Madrid

Phone +34 91 572 67 11

Milan

Via Nino Bixio, 31
20129 Milano MI

Phone +39 02 30315 814

Scope Ratings UK Limited

London

52 Grosvenor Gardens
London SW1W 0AU

Phone +44 20 7824 5180

info@scoperatings.com

www.scoperatings.com