Auto ABS Rating Methodology

Structured Finance

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1. Introduction

This document is an update of Scope Ratings GmbH's (Scope) Auto ABS Rating Methodology, published in August 2017. This update consists of editorial changes to improve readability and introduce editorial changes. Minor additions clarifying our approach can be found in Figure 1, Section 4.3.3 and Section 5.4.2. This methodology update does not propose any material changes to our existing rating approach and existing structured finance ratings based on this methodology are not impacted.

2. Ratings and applicability

This document describes Scope's methodology for rating securitisations of granular portfolios[1] which comprise loans or leases that finance new or used vehicles, generally referred to as auto ABS. It first explains our analysis of auto ABS which securitise only lease or loan instalments, and subsequently outlines the analysis of residual value and voluntary termination risks, thus providing a general framework that can be applied to any auto loan or auto lease transaction.

This methodology complements the General Structured Finance Rating Methodology and should be read together with the Rating Methodology for Counterparty Risk in Structured Finance. This methodology may be applied to auto ABS outside Europe.

3. Methodology highlights

Greater differentiation. Scope's analysis relies on transaction-specific input assumptions. Scope uses a fundamental bottom-up approach to capture the different credit and market risks related to assets, portfolio and structure, all of which are considered in the context of the originator and the relevant jurisdiction. Scope sequentially analyses these elements, taking into account the transaction's legal and counterparty aspects. This approach allows greater rating and transaction differentiation, even for transactions with the same originator and in the same country.

Comprehensive framework. This methodology defines a comprehensive analytical framework for rating auto ABS securitisations exposed to credit risk; credit and residual value risk; or credit, voluntary termination and residual value risk. The latter being characteristic of auto ABS transactions in the UK.

Originator analysis. Scope leverages on the originator's knowledge of its customers and new/used auto markets. We analyse market positioning, product portfolio, origination strategy, risk management and monitoring, and recovery functions to provide a qualitative framework to build an informed credit view of the assets.

Highly granular approach. Scope analyses auto ABS portfolios under the assumption that they are highly granular, using historical performance references of defaults and recoveries from vintage data to help refine our views on given portfolios. The analysis of simple and transparent auto ABS is straightforward, involving the analysis of portfolio losses and cash flow distributions.

No mechanistic link to sovereign credit quality. Scope does not mechanistically limit the maximum rating a securitisation can achieve as a function of the sovereign credit quality of the country in which the assets are located. Instead, we assess convertibility risk, capital controls risk, and the risk of institutional meltdown in the context of the tenor of each rated tranche. We also factor macroeconomic considerations into the ratings.

Post-crisis counterparty risk. Scope applies its understanding of several new bank recovery and resolution regimes created after the 2008 financial crisis. Traditional counterparty risk analysis and rating triggers in the context of these new regimes provide significant comfort that roles such as transaction account bank or servicer can be performed by resolvable financial institutions without limiting the highest rating achievable by a securitisation, provided adequate structural protections are in place.

Stable senior protection. The methodology promotes stable protection buffers through the cycle for AAA_{SF} ratings. We focus on a long-term view complemented by market performance references for the specific country, so as to minimise distortions of protection levels caused by default rate volatility over an economic cycle in the relevant jurisdiction.

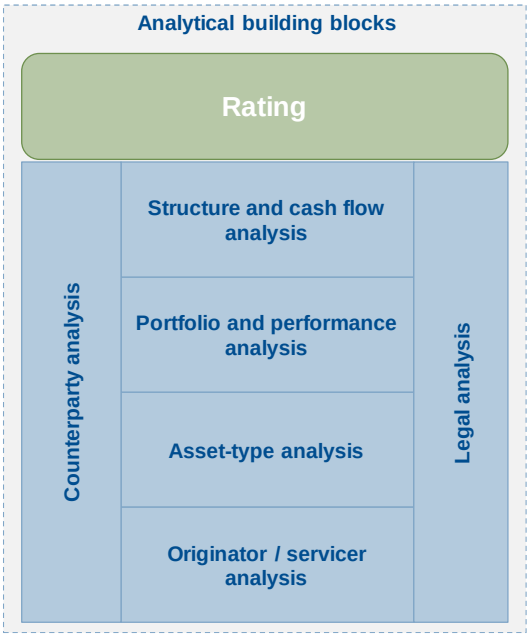
[1] The granularity metric employed by Scope is the diversity index with an order of diversity of two, which is the inverse of the Herfindahl index. A portfolio is considered granular when the effective number of obligors exceeds 500.

4. Overview of analytical framework

The analytical framework covers six areas: i) the originator and servicer[2]; ii) asset types; iii) the portfolio and performance; iv) cash flow and structure; v) counterparties; and vi) the legal framework.

Scope's structured finance ratings reflect an investor's expected loss on a securitisation in the context of the investment's expected weighted average life. The expected loss accounts for the time value of money at the rate promised to the investor on an instrument. Our General Structured Finance Rating Methodology provides more detail on how we implement expected loss ratings.

Scope derives assumptions on the default rate, correlation and recovery for the portfolio using transaction-specific data, generally from the originator, and market data. We analyse the portfolio's defaults assuming an inverse Gaussian distribution. The portfolio default distribution is then used to analyse the transaction's cash flows. The cash flow analysis incorporates key assumptions such as asset amortisation, prepayment rates, recovery rates, cure rates, default timing and interest rates. Scope analyses the expected loss of a tranche by applying recovery rate assumptions that have higher haircuts for higher-rated tranches (rating-conditional haircuts).



Scope accounts for losses of portfolio value arising from residual value risk and voluntary termination when these elements are present in an ABS transaction. The analytical framework reflects the inversely interdependent nature of losses from obligor-related defaults as well as losses from exposures to residual value and voluntary termination, when present in a transaction.

Scope takes into account qualitative and quantitative elements when analysing a transaction, while also taking into consideration a rating's sensitivity to key analytical assumptions. Quantitative analysis or elements alone do not dictate the final rating because the analysis also reflects qualitative and fundamental credit views on the key risks of an auto ABS transaction.

In this document we present the six areas of analysis, as mentioned above, for new securitisations and the monitoring of outstanding securitisations. The originator and servicer are usually the same entity in auto ABS transactions. Therefore, in this methodology, we generally refer to both roles as the originator.

4.1. Originator and servicer analysis

Scope believes that the quality of the originator and servicer[2], their business strategy, experience and track record in the industry, are key factors in determining how well an asset performs. We analyse the history of originated volumes and the originator's performance to build a view on the stability of the business model and the performance of the assets. Several types of entities can originate auto ABS assets, including regulated banks, regulated specialty lenders, dealer networks, leasing companies, and general or specialised brokers acting as intermediaries. Each type carries with it a distinct risk profile.

Scope leverages on the originator's knowledge of its customers and the relevant vehicle markets in which it operates. We analyse the market positioning, product types, origination strategy, risk management and monitoring, and recovery functions of these entities to form the qualitative framework needed to develop an informed credit view on the securitised assets. Particularly relevant for auto ABS transactions is the originator's ability to size vehicle-value risk over the life of the credit contract, and its ability to directly or indirectly place vehicles in the market.

Scope analyses how and to what extent the interests of the originator and the manager of the special-purpose vehicle are aligned with those of the investor in the securitisation. An originator's interest in the transaction is important for building a view of the originator's expected performance and the quality of its underwriting. Scope analyses the relationships and incentives between the originator and brokers or the dealer networks, as well as between manufacturer groups and captive financial institutions.

[2] The originator and servicer are usually the same entity in auto ABS transactions. Therefore, in this methodology, we generally refer to both roles as the originator.

The information we receive from the originator complements public information and enables us to interpret the credit performance, residual value and voluntary termination of the assets, where applicable. We incorporate these interpretations into our base case analytical assumptions.

A list of typical themes covered during originator analysis is shown in Figure 1.

Figure 1. Areas of originator and servicer analysis

Theme	Interest
Market positioning and strategy	We analyse the stability of strategy over time: whether products and obligor segments have been time-tested. When available we analyse the history of originated volumes and the originator's performance to develop a view on the stability of the business model and the performance of the assets.
Risk appetite	A more volatile expected performance may be caused by: the implementation of low credit-scoring cut-off levels aimed at gaining market share at the expense of the loan's credit quality or rapidly growing origination volumes.
Staff, systems and processes	We review the originator's operational competence, capacity and expertise in managing assets relevant to the transaction.
Underwriting standards	We consider the originator's adherence to best practice with respect to internal controls, documentation and processes, and, principally, the risk function's degree of independence and power.
Origination stability and performance	We compare the originated assets' stability and credit performance with the volume and credit performance of the entire market and/or peers.
Origination channel(s)	Several types of entities can originate auto loans, including regulated banks, finance companies, and specialised brokers acting as intermediaries. Each origination practice can result in distinct risk profiles. Loan underwriting performed via branches with face-to-face meetings, via brokers or via internet platforms may exhibit different debtor risk profiles. A face-to-face meeting generally implies a more complete picture of the financial standing of the borrower, who is often already an existing bank customer. In the case of loans originated via internet platforms, borrowers are likely to be more opportunistic and seek the lowest interest rates. The marketing approach of the originator may affect Scope's prospective view on default rate levels. Scope analyses whether the origination channel or an extensive cross-selling practice creates the risk of borrowers being enticed into taking out loans that are unsuitable or unnecessary.
Cross-selling	Extensive cross-selling of financial products by a lender could create a link (actual or perceived) with the auto loan. This could prompt borrowers to set off any losses incurred in cross-sold products, such as insurance or deposit accounts, against amounts owed on the auto loans, thus impacting their willingness to repay. Such risks generally require a legal analysis to determine the extent to which borrowers can set off amounts due on their loans, as well as an analysis of structural features that can mitigate this risk such as set-off reserves.
Credit-scoring systems and risk models	An originator that can demonstrate sound, stable and predictive credit-scoring systems may be subject to a lower default volatility. During our review of the originator's underwriting processes we consider, among other elements, whether the underwriters use external and/or internally developed credit-scoring cards. We also assess how and how often credit-scoring systems are validated/reviewed. Residual vehicle-value risk models are also examined when applicable.
Monitoring and recovery strategy	Relationship management, pre-non-performing-loan management and recovery management.
Fraud prevention	We review the tools used to prevent and monitor fraudulent transactions such as account or identity theft, loan stacking and other similar issues. The robustness and stability of processes to select borrowers and validate loan applications play an important role in reducing the volatility of loan portfolios. Scope takes into account documentation and investigations surrounding loan applications and approvals. Extensive documentation can give a clearer picture of the borrower's ability to repay and helps to avoid fraud.
Alignment of interests	Scope judges how well the interests of brokers are aligned with those of the originator, when the latter relies on such networks for origination. Scope also analyses how and to what extent the interests of the originator/servicer are aligned with those of the investor in the securitisation.
Used-vehicle market	We assess the originator's strategy and expertise in liquidating used vehicles in a timely and efficient manner.

4.2. Asset and contract type analysis

A summary of possible features found in auto loan and leasing contracts can be found below in Figure 2. The relevance of some features is limited to specific jurisdictions. For example, the UK's Consumer Credit Act grants obligors the option to voluntarily terminate a consumer loan[3].

Figure 2. Possible features found in auto-finance contracts

	Owner of vehicle title	Balloon payment at maturity	Residual value risk	Voluntary termination risk
Fully amortising loan	Obligor	No	No	No
Fully amortising lease	Lessor	No	No	No
Balloon payment at maturity	Obligor/Lessor	Yes	No	No
Turn-in of vehicle in lieu of balloon payment	Obligor/Lessor	Yes	Yes	No
Voluntary termination option (UK)	Lender	Yes/No	Yes	Yes

Scope also analyses the characteristics of the binding vehicle financing contracts that constitute the securitised assets:

Amortisation profile	French, balloon, down payments
Maturity and prepayment options	Payment-in-kind via vehicle turn-in
Interest-related characteristics	Fixed /floating interest rates, rate reset frequency, payment frequency
Type of security on the vehicle	Ownership, reservation of title, no security
Relation to specific obligor groups	Promotional contracts
Relation to possible linked contracts	Insurance or maintenance
Origination channel	Captive originator, partner network, third parties

4.2.1. Exposure to obligor default risk

Most auto ABS transactions represent the securitisation of plain-vanilla loans or leases granted to finance a vehicle. The financed amount can be amortised in equal instalments and may include a balloon payment. These credits involve full recourse to the obligor and may be secured by the vehicle's value. Losses from these contracts depend on the obligor's probability of default, the amortising exposure, and the loss severity after recovery. Thus, loan or lease performance can be analysed using a lifetime default rate and a recovery rate.

4.2.2. Exposure to vehicle residual-value risk

Residual-value risk results from the securitisation of the residual value of the vehicle, which occurs at the point when an obligor can hand in the vehicle in lieu of all outstanding instalments. Residual-value risk also arises when liquidation proceeds from a lessor's sale of the vehicle after the maturity of the lease contract are securitised. These exposures do not constitute the obligor's credit risk, but rather the risk on the vehicle's value at a future point in time. The right to voluntarily terminate the contract by turning in the vehicle before or at maturity constitutes such vehicle-value risk.

Residual-value risk in a transaction greatly depends on the prudential practices of the lender or lessor. Experienced originators set terms in their contracts to avoid negative equity in the vehicle to mitigate the risk of a residual-value loss when the vehicle is liquidated.

See Appendix II and Appendix III for our treatment of auto-finance contracts exposed to residual-value risk.

[3] Obligors are entitled to terminate the loan contract by returning the vehicle once 50% of the amounts due have been paid. Amounts due include principal, interest and any down payment. The turn-in of the vehicle extinguishes all claims against the obligor.

4.3. Portfolio and performance analysis

Scope analyses the loan/lease characteristics and the historical performance of similar pools to define the key quantitative assumptions on the securitised assets, such as portfolio defaults, recoveries, delinquency cure rates, prepayment rates and expected yield. Scope applies a fundamental bottom-up approach to capture the credit risks resulting from the different characteristics of the assets, the portfolio or structure. This allows for greater rating and transaction differentiation, even for transactions with the same originator and in the same country.

When justified, we incorporate a long-term view on asset performance, complemented by market references for the specific country, to reduce distortions of protection levels resulting from default rate volatility over an economic cycle. This approach is most relevant when the historical performance data provided by the originator does not reflect default volatility over a full economic cycle.

4.3.1. Analysis of portfolio defaults

Scope has applied lessons from the last financial crisis to its analytical approach. The protection levels necessary to support ratings in the AAA_{SF} category under this methodology are not distorted by performance data from very benign periods and are designed to remain reasonably stable throughout recessions.

4.3.2. Point-in-time and long-term default distributions

When appropriate, Scope takes into account two different portfolio-default distributions: i) at a point in time; and ii) in the long term. We analyse both using the same inverse Gaussian probability function but with different means and different coefficients of variation[4]. This probability function neatly matches the probability distribution of defaults that can be obtained from a Monte Carlo simulation for very granular portfolios. The inverse Gaussian distribution is also simple because it is fully characterised by the mean and coefficient of variation.

Point-in-time distribution. This distribution reflects expected portfolio defaults based on historical data, ideally vintage data provided by the originator. Historical data is complemented with factors specific to the origination or product, as well as macro and microeconomic conditions. We analyse recent historical performance in the form of vintage data analysis and extrapolate to the assets' risk horizon. This leads to a portfolio default-rate mean and coefficient of variation. See Appendix I for technical notes on how we apply vintage analysis.

Long-term distribution. This distribution reflects portfolio defaults expected by Scope under a long-term average credit environment, representing our through-the-cycle view. We analyse a long-term data series to derive a portfolio's long-term mean default rate and coefficient of variation. Long-term data series may be either provided by the originator or extrapolated with the support of macroeconomic factors which closely correlate to the individuals' credit performance. For example, GDP and wage growth and unemployment rates can be used to infer consumers' default rates over a full economic cycle.

The long-term distribution of defaults may differ from recent historical performance. For example, the long-term mean default rate assumption could be higher than any default rate observed in the originator's vintage data set when this data does not cover a period of significant stress. Depending on the length of data history provided by the originator, point-in-time and long-term means may converge. Scope also expects the two curves to broadly converge for jurisdictions in which economic performance has been relatively stable over a long time, such as Germany. In cases where the long-term mean default rate is lower than the point-in-time default rate, Scope may only give partial credit to the long-term performance if credit-trend fundamentals are changing or uncertain. For example, a past cycle may become irrelevant upon a significant change in consumer lending laws, or other fundamental factors such as the structure of the labour market.

4.3.3. Estimating mean default and volatility of the default distribution

Scope analyses performance data (ideally vintage data) provided by the originator/servicer that is representative of the assets to be securitised in order to estimate the portfolio's cumulative mean default rate and the volatility of the default distribution.

[4] The coefficient of variation is the standard deviation divided by the mean (i.e. it is a normalised standard deviation). The shape parameter of the inverse Gaussian distribution can be expressed as $\lambda = \mu / CoV^2$. Throughout this report, we will refer to both the standard deviation and the coefficient of variation as equivalent measures of volatility of the default distribution.

Seasoning effect. Scope adjusts vintage data to capture the effect of seasoning on the assets. This adjustment (rebasing) produces the remaining cumulative default rate that applies to the securitised portfolio, rather than the lifetime default rate of the assets since origination.

Default trends. Scope considers recent vintage trends which may reflect a change in the originator's underwriting criteria or in the macroeconomic environment. Analysis of recent delinquency data also provides meaningful insight.

Segment-specific data. If segment-specific data is available, Scope may split the portfolio into segments with similar characteristics (e.g. new cars, used cars, trucks) and derive a mean default rate and coefficient of variation for each. Information specific to each portfolio segment is relevant if: i) the weights of the portfolio's segments differ to those in the originator's entire book; ii) the segment weights have materially changed; or iii) the portfolio is exposed to asset types with significantly different characteristics. We expect segment-specific vintage data provided by the originator to reliably reflect the characteristics of the relevant segments (see 'Data adequacy').

Benchmarking. Scope may also compare the analysed portfolio with relevant market data and with portfolios of similar originators across Europe, considering the performance of transactions that survived the most recent recession.

Credit risk models. For originators with a limited track record, Scope may derive performance assumptions using available market benchmarks and based on the soundness of the originators' underwriting processes. This includes the analysis of the number and quality of data sources underlying credit risk models or decision-making algorithms. Important risk drivers in this context are the originator's risk appetite, the alignment of interests between the originator and investors, and the qualifications of the management team.

4.3.4. Information balancing long-term available historical performance

Impact of origination and servicing. Scope interprets and adjusts loan performance data based on the originator and servicer analysis as described in Section 4.1. Origination and servicing will affect asset performance under normal macroeconomic conditions and, more importantly, the default volatility over macroeconomic cycles. For instance, similar performance during a benign economic period of two originators with different origination styles could hide very different expected default volatilities in an adverse economic scenario.

Macroeconomic context. We incorporate our macroeconomic expectations into our default parameter assumptions, especially if we believe portfolio performance data does not cover a full economic cycle, e.g. if the performance was observed during a long period of benign economic conditions.

4.3.5. Standard performance reference using cure rates to adjust for different default definitions

Scope performs a default rate analysis of auto ABS transactions based on a generic default definition, ideally 90 days past due (dpd). The 90 dpd reference is nevertheless a 'late' default metric when applied to auto ABS. Scope's analysis of roll rates in the delinquency pipeline provides an early warning of a deteriorating performance.

When the default definition in a transaction does not match that of the vintage data provided for the analysis, Scope will derive a cure rate. Cure rates effectively represent the amount recovered from delinquent obligors who are reperforming (e.g. are repaying missed payments). These apply to obligors who have not rolled into default as defined in the transaction documents. Fully cured delinquency positions have recovered all due and payable interest and principal, making them current.

Scope's analysis incorporates the impact of cure rates on a portfolio's cash flows. Our cure rate assumptions are kept constant for all rating categories. Like defaults, delinquencies impact a transaction's liquidity as overdue instalments move through the delinquency buckets and ultimately default or cure.

4.3.6. Default timing

Scope derives a default timing assumption specific to the transaction, considering the characteristics of the securitised asset. Scope generally applies a front-loaded default timing, reflecting a constant default intensity that follows the portfolio's amortisation.

4.4. Recovery analysis

Scope applies fixed and rating-conditional recovery rates, which means different recovery rates are applied depending on the instrument's target rating. We typically apply recovery assumptions based on historical data (applicable to obligor defaults) and/or fundamental data (applicable to vehicle turn-ins).

4.4.1. Recovery analysis applicable to obligor defaults

Scope derives the base case recovery rate from vintage analysis, which forms the starting point for the recovery analysis. Scope then analyses the expected loss of a rated tranche by applying rating-specific recovery rate assumptions, which are tiered to represent ever-growing haircuts as the rating target becomes higher.

As recovery rates depend on the rating, this approach ensures higher ratings can withstand higher stresses and account for the sensitivity of higher-rated tranches to the volatility of recovery rates. Figure 3 shows the indicative recovery rate haircuts Scope applies when analysing auto ABS transactions. For example, if the base case recovery rate derived from the vintage analysis is 50%, the recovery rate when analysing portfolio losses under a AAA stress is 30% = 50% x (1-40%), based on indicative haircuts highlighted in Figure 3. These haircuts represent a floor, where higher recovery rate volatility would result in increased haircuts.

Figure 3. Indicative recovery rate haircuts

Rating stress	B (base case)	BB	BBB	A	AA	AAA
Haircut	0%	8%	16%	24%	32%	40%

Scope derives recovery-timing assumptions from the term structure of recoveries observed. The main factors driving the time to recovery are: i) whether there is a strong and efficient security on the vehicle; ii) the characteristics of the second-hand car market; iii) the characteristics of the vehicles underlying the contracts; and iv) the servicer's general recovery strategy.

4.4.2. Loss assumptions for vehicle turn-ins

Scope estimates the loss caused by vehicle turn-ins by calculating the difference between total outstanding payments and the stressed market value of the vehicles. Scope applies stress factors that increase with the rating of the instrument and affect: i) depreciation and age; and ii) idiosyncratic vehicle-value decline, which is exhibited through an obligor's motivation to turn in a vehicle. We analyse a vehicle's depreciation by applying a monthly market-value-decline assumption to the vehicles' diminishing value in the portfolio, which ranges between 1.5% and 2.5% (see Appendix III and Appendix IV). The monthly depreciation rate captures wear and tear, as well as depreciation driven by changes in technology, emissions standards or safety regulations.

We derive the vehicle's age from the point when we assume the obligor will turn in the vehicle, plus the time the servicer would then need to sell the vehicle in the market. For voluntary terminations, we assume the obligor will exercise the right to terminate the contract as soon as it is legally possible, i.e. when at least 50% of the financed amount is paid in the case of the UK. For contracts under which the obligor can hand in the vehicle in lieu of a final instalment, this point in time is set by the date of the last instalment under the contract.

The effect of depreciation is often offset by the deleveraging of the contract. Deleveraging reduces the loan-to-value ratio, whereas depreciation increases it. Therefore, the prudential practices of the originator determine whether vehicle-value losses are material for a given transaction.

We believe that vehicles are in below-average condition when obligors choose to voluntarily terminate a contract and turn in the vehicle, or if they choose to turn in the vehicle when the contract matures. This supports a haircut to the theoretical average market value of a vehicle.

This analysis assumes that the security on the vehicle cannot be challenged legally. We expect clear legal opinions regarding the security available on the assets. For example, we expect strong opinions on the enforceability of clauses that relate to reserving the title of a vehicle.

Appendix II and Appendix III explain the details of calculating losses from vehicle turn-ins.

4.5. Prepayment analysis

Our analysis considers high and low prepayment scenarios. High prepayment stresses are derived from historical highs observed by the originator, which we fix for the life of the transaction. A low prepayment stress is the 0% constant prepayment rate

assumption. Scope may apply a different prepayment framework when justified by a specific asset type or macroeconomic expectations (e.g. changes to interest rates).

4.6. Assessment of portfolio concentrations

A concentration on manufacturers, brands or models may increase losses for auto ABS transactions, whether from lower recovery rates on defaults or higher losses from vehicle-value risk. Scope addresses high manufacturer or brand concentrations by complementing the statistical analysis with a fundamental view on event risk, in cooperation with Scope's corporate ratings team.

5. Structure analysis and cash flow analysis

Specific structural features may benefit some investors but harm others, and our analysis aims at capturing these differences. Scope considers the portfolio default rate distribution to perform a cash flow analysis which reflects the transaction's priority of payments and specific features. The cash flows available to a specific tranche allow Scope to calculate the expected loss and weighted average life for this tranche, which reflect the probability-weighted average values for all possible portfolio default rates.

5.1. Cash flow analysis

Scope calculates losses on each note class by projecting the cash flow generated by the securitised portfolio, taking into account the transaction's structural features. On the asset side, the main inputs into the quantitative analysis are Scope's assumptions on default probability distribution, cure rates, default timing, recovery rate, recovery timing, prepayment rates, the asset amortisation profile, and portfolio yield. On the liability side, the main inputs are the priorities of payments, size of the notes, expected coupons, transaction fees and expenses, any reserves covering liquidity or credit risk, any transaction triggers and, in some instances, a quantification of certain identified counterparty risks.

The quantitative analysis determines cash flows available for the tranches for each default scenario as well as the associated probability of that scenario. Scope then calculates the expected loss and weighted average life for each class of note, which are mapped to our expected loss tables to determine the corresponding ratings as explained in Scope's General Structured Finance Rating Methodology (dated August 2017 and available at www.scoperatings.com). Qualitative counterparty and legal analysis is then applied to assess unquantifiable factors.

The quantitative analysis alone does not dictate the final rating assigned to an instrument because our rating outcome reflects qualitative and fundamental credit views which are not captured in the quantitative analysis.

5.2. Notable structural features

5.2.1. Revolving portfolios

Auto ABS structures often feature replenishing or revolving portfolios. This results in an extension of the transaction's life, leading to potential portfolio quality migration over time and an increased risk exposure compared to the static-portfolio equivalent.

Typically, the migration of portfolio quality is limited by asset and portfolio covenants. Scope analyses the risk of portfolio migration in the context of the history and strategy of the originator, the characteristics of the asset type, as well as the asset and portfolio covenants available in the structure.

Furthermore, revolving auto ABS transactions usually feature early-amortisation triggers to limit credit quality deterioration during the revolving period. We assume a reasonable level of deterioration in the portfolio's performance within the limits set by early-amortisation triggers and Scope's own expectations. We thus analyse the amortisation phase by assuming that credit losses during the revolving phase will have eroded a fraction of the credit enhancement available to the tranches. The amount of credit loss during the revolving phase will largely depend on the performance-based early-amortisation triggers defined in the structure.

We then analyse the amortisation phase of the transaction based on expected portfolio migration and the erosion of credit enhancement, and benchmark the expected loss on the rated instrument with its expected weighted average life over the amortisation phase.

5.2.2. Call options

In general, Scope does not incorporate options to terminate a transaction prematurely into its quantitative analysis because call options are discretionary and typically require the originator to repurchase the outstanding portfolio of assets under the condition precedent that all liabilities be repaid in full.

5.2.3. Reserve accounts

Some structures feature generic cash reserves which not only support liquidity, but can also be used to accelerate the amortisation of the notes. This creates a risk that the cash reserve may be depleted, leaving the structure without liquidity support. This risk is generally remote, however, as these structures often feature a combined or a 'separate and interconnected' priority of payments, which allows principal collections to be used to pay interest on senior tranches.

Scope only assigns high ratings in the AAA_{SF} or AA_{SF} categories to instruments which can be expected to receive timely interest payments, even upon servicing disruptions. Scope analyses whether liquidity support in the structure can reduce the risk of missed interest payments over certain (potentially long) periods, for example, the time needed to replace a disrupted servicer.

5.2.4. Interest rate risk

Unhedged exposures to interest rates are examined to determine whether they could represent a material source of loss for the rated instrument. Scope typically assesses whether an instrument is exposed to interest rate risks, examples of which include mismatches in the basis, fixed/floating nature, or re-set timing between the assets and liabilities in a transaction. Some auto loans may pay a fixed interest rate, whereas notes usually pay a floating rate. Therefore, fixed-floating risk is more common than basis risk. We assess basis risk for floating-rate loans, considering the effective coverage provided by natural hedges. For example, Scope acknowledges the high correlation between indices which ultimately refer to Euribor indices in the eurozone. Also relevant in this area is the reset risk stemming from differences in date when the notes and assets reset, as well as the differences in frequency with which the notes and assets reset.

5.2.5. Portfolio yield and yield compression

The portfolio yield for each period is generally provided by the originator in the form of a yield vector, considering the contractual yield of each loan in the securitised portfolio. For revolving portfolios, Scope considers potential changes in the yield vector caused by the addition of new assets. Transaction documents usually set a minimum guaranteed yield either on an aggregated basis or for each added loan. Scope applies interest rate assumptions for the loan using haircuts that reflect risks of yield compression. Such risks may arise if a loan with a high interest rate is prepaid or defaults more quickly than other loans do. Yield compression may also be the result of a loan being renegotiated between the originator and the debtor, which is generally allowed by transaction documents up to a certain limit. Structural features may also impact interest collections that protect investors against losses. Generally, excess spread (interest collections available after the notes' senior fees and interest are paid) is available on a 'use it or lose it' basis. Therefore, priorities of payments designed to use excess spread to cover cash flow shortfalls arising from portfolio defaults and delinquencies and to refill transaction cash reserves are beneficial for investors. Some structures also feature triggers that keep all excess spread in the structure if portfolio performance deteriorates, making it available for potential payment shortfalls in future.

5.2.6. Fees

Scope assumes estimated fees to be paid to senior transaction parties, for example, the trustee, the account bank, the corporate servicer, the cash manager, and the servicer. When the servicer is the same entity as the originator, servicing fees usually become lower, given the servicer's interest in the transaction. In any case Scope still assumes higher servicing costs in its analysis, because if the servicer was replaced, fees charged by the new servicer would be at market level. Scope generally assumes that servicing fees are accounted for as a percentage of the outstanding portfolio amount, and that in some cases they can be supplemented with caps and floors. We also assume a minimum for servicing fees, expressed in an absolute amount (local currency). The amount of stress applied on fees to account for counterparty replacement depends on the complexity of the tasks performed by the counterparty and the availability of competitive alternative providers.

5.3. Legal risk analysis

In Scope's view, legal risks can arise from three main sources: i) the assets and the transfer of these assets to the special purpose vehicle; ii) the special purpose vehicle issuing the rated debt and its legal structure (e.g. bankruptcy remoteness); and iii) the transaction parties. Scope reviews legal opinions to gain comfort on the assumptions made on relevant legal issues.

For auto ABS transactions specifically, we focus our legal analysis on: i) consumer protection statutes under the laws governing the contracts; ii) the validity of rights assigned over liquidation proceeds; and iii) potential liabilities for the issuer created by linked contracts, which could result in losses from setting off claims (from customer deposits or insurance policies paid upfront). Among these, all aspects of vehicle-value risk and voluntary termination are critical when analysing auto ABS portfolios.

5.4. Counterparty risk analysis

Scope evaluates how risks are linked between the rated instruments and the various parties to the transaction. Scope assesses the materiality of a counterparty exposure as excessive, material or immaterial. We distinguish financial risk from operational risk and assess the transaction's ability to mitigate or reduce counterparty risk. For more information refer to Scope's Methodology for Counterparty Risk in Structured Finance, available at www.scoperatings.com.

Generally, we expect that upon a financial impairment, resolvable financial institutions can continue as a going concern and honour operational contractual obligations for at least the duration of the resolution process. This view provides reasonable comfort that the structure can implement mechanisms against counterparty risk before it effectively crystallises. Likewise, this view limits our concerns over the disruption of any servicer that is a regulated and resolvable bank.

The honouring of contractual obligations through a resolution process also has significant implications for leasing transactions when proceeds from the leased object are pledged to the securitisation fund by the originator as a form of security. We believe that the recovery rate assumption in a leasing ABS can benefit from such a security, even in rating scenarios above the issuer rating of a resolvable bank. Scope considers the amount of bail-in-able capital and the tenor of the exposure when setting the rating-conditional recovery rate assumptions for a portfolio of leasing contracts for rating categories higher than the bank issuer rating of the originator.

Auto ABS transactions may also feature unrated servicers which may not be regulated as banks are. A jump to default of such a servicer would result in extra losses for investors or temporarily interrupt payments. Further, a defaulted servicer should be readily replaced to avoid more delinquencies and defaults which could worsen a transaction's losses.

5.4.1. Servicer commingling risk

Servicer commingling risk is the risk that moneys of the issuer held by the servicer are commingled with the insolvency estate of a defaulted servicer. The materiality of this risk depends on several factors: i) the servicer's credit quality; ii) the legal framework under which the servicer performs its functions; iii) the existence of pledged or dedicated accounts, such as escrow accounts; iv) the ease of preventing collections from obligors upon a servicer event (e.g. direct debit collections); v) provisions in place to notify debtors to redirect payments into an account in the issuer's name; vi) the payment method used by the borrowers (e.g. wire, pay cheque, direct debit); vii) the frequency with which the servicer's funds are transferred into an account in the issuer's name; viii) the length of servicer holding periods as a function of the frequency of cash sweeps; and, generally, ix) receivables characteristics which determine the amount and potential clustering of collections around certain dates.

Scope considers the ability of structural protection features such as a dedicated commingling reserve or guarantee to delink risk from the servicer. For example, a reserve held in the issuer's name, which fully covers collections over a stressed servicer holding period, effectively delinks a transaction from servicer commingling losses.

When full delinking from the servicer is not possible, Scope will incorporate into the analysis any uncovered exposure to the servicer by considering the servicer's likelihood of default and the amount of collections at risk. For more detail, refer to the Methodology for Counterparty Risk in Structured Finance, available at www.scoperatings.com.

5.4.2. Set-off risk

Set-off may be invoked by a debtor that holds a monetary cross-claim against the seller or originator. In this case, the debtor may be absolved from honouring the creditor's claim up to the amount of the cross-claim.

In the context of auto loan transactions, set-off risk typically arises when the originator is holding the obligors' deposits. These obligors may exercise set-off rights if they lose access to their deposits (for example, upon the originator's insolvency), which could substantially reduce or cancel out the enforceable claim, i.e. the proceeds payable to the issuer, creating a loss for the transaction.

As set-off risk can vary significantly by jurisdiction, Scope analyses jurisdiction-specific laws. To determine the extent of set-off risk, we generally consider the following:

1. The probability of the originator going insolvent.
2. The structural protections in place, such as a dedicated reserve or the undertaking of the originator to not open accounts with the securitised debtors.
3. The existence of country deposit-scheme guarantees. For example, deposits in the EU are guaranteed up to EUR 100,000.
4. Whether the notice of assignment of the portfolio transfer to the issuer 'crystallises' the amount an obligor may set off against the issuer (equal to the amount that was credited to the debtor's bank account at the time of the notice).

5.4.3. Provisions to mitigate servicing disruptions and liquidity risk

Scope analyses liquidity available to pay senior fees and interest on non-deferrable classes particularly in the context of servicing disruptions and servicer transfer.

Auto loan ABS transactions often feature backup servicer arrangements, such as the appointment of a warm/hot backup servicer at closing, or a party that will facilitate the search for a suitable backup servicer. These structural features aim to reduce the time of the handover to a new servicer, thus reducing the risk of missed payments on the notes. Without a backup servicer in place, a servicer disruption may pose liquidity risk for the issuer, as the portfolio may not be serviced for some time. The time between finding a new servicer and an effective takeover of servicing activities will depend on alternatives in the market, how easily the new servicer can access the payment information on the receivables and the obligor database, and the operational complexity of migrating certain servicing processes to a new platform.

6. Rating sensitivity

Scope's analytical framework applied to structured finance transactions is designed to result in rating stability for high investment grade ratings. Two mechanisms allow for this: i) rating-conditional stresses; and ii) the use of a 'long-term' asset-default distribution which represents a through-the-cycle view (see 4.3.1 'Analysis of portfolio defaults').

Applying rating-conditional recovery rates adds greater stability to high ratings. This reduces rating volatility because deviations from initial base case assumptions can be absorbed during monitoring by the protective cushions of the ratings, which become larger as the rating becomes higher.

Scope's transaction rating reports show the stability of ratings with respect to shocks applied to relevant analytical assumptions. Sensitivity tests to shifts in the mean default rate and expected recovery rate illustrate how intensely, and in which direction, ratings depend on the quantitative assumptions. Sensitivity test scenarios should not be interpreted as likely or expected scenarios for the transactions.

Figure 4 shows the typical scenarios we report as part of the rating analysis. We analyse excessive sensitivity to key analytical assumptions and could decide to lower the final rating assigned to increase the rating's stability.

Figure 4. Typical sensitivity tests considered during the analysis

Analytical assumption tested	Shifts considered
Mean default rate	+ 50%
Recovery rate	– 50%

Scope may also show the default rates for which no loss is seen for a given tranche (break-even default rates) – under the rating-conditional recovery assumption as well as under zero recoveries. This information can provide investors with another analytical angle to understand the resilience of the rated tranches.

7. Data adequacy

Scope acknowledges that risk information systems and the disclosure of large and medium-sized banks have improved both in volume and quality since the crisis, particularly with regard to monitoring and recovery functions.

We leverage on market and macroeconomic data to extrapolate available performance references, and we complement the analysis with a thorough, fundamental study of the originator's strategy, underwriting criteria and processes and their changes over time, as well as the processes and systems of the servicer.

Scope's bottom-up approach allows us to build a differential credit view on the originator, the assets and the portfolio. We assess the adequacy of information received towards this objective. Scope may request an explanation regarding the limitations of available data and more details when the information available is insufficient to analyse a transaction.

7.1. Historical information

Scope relies on historical information, ideally in the form of vintage data that is representative of the assets to be securitised. Segment-specific information is relevant when the segments' weights differ to those in the originator's entire book; when these weights have materially changed over time; and contract types in the portfolio exhibit significantly different characteristics (i.e. the vehicle-value risk on a contract).

Scope also ensures that the granularity of performance references is enough to derive statistically significant base cases.

7.2. No portfolio data template

Scope does not use a proprietary portfolio template for auto ABS portfolios. Instead, Scope views positively an originator's adherence to the portfolio reporting standards set by the ECB taxonomy and adopted by the European Data Warehouse – if this template has information that is relevant for analysing assets' risk characteristics (i.e. vehicle-value risk and credit risk). In any case, Scope can also work with other templates that allow an analysis of credit characteristics of assets in a portfolio and a comparison of these to the characteristics of the originator's entire book.

7.3. Data checks

Scope assesses the plausibility of the information received from originators and other sources, even when Scope considers these to be reliable and accurate. We might need additional information or clarifications from an issuer or its agents when the available information conflicts with our understanding of the data. These 'sanity checks' do not, however, comprehensively verify the reliability and accuracy of the information and data used by Scope during the rating analysis.

Reports on agreed-upon procedures performed by reputable, independent auditors limit the potential difference between the data supplied to Scope and the paper or computer files containing data provided by the originator/seller.

We believe that the degree of the originator's alignment of interests, or the independence, experience and financial strength of parties providing information to Scope, increase the reliability of information. For example, independent legal opinions generally support our legal analysis, whereas representations by an affected party would not be deemed as robust.

Conference calls and operational review visits also provide Scope with more details on the data and information received. When necessary we review files to understand the processes presented during the operational review visit, or to better understand the assets being securitised.

8. Monitoring

Scope monitors auto ABS transactions using performance reports produced by the management company, the trustee or the servicer. The ratings are monitored continuously and reviewed at least once a year or earlier if warranted by events.

Appendix I Vintage data analysis

Consolidation and extrapolation of vintage data

Scope consolidates vintage series into an annual series before calculating the coefficient of variation of the default rates for a given portfolio segment. This approach standardises the analysis across transactions and increases the granularity of the vintage series used for the analysis. Scope extrapolates incomplete annual vintage series, accounting for the term structure implicit in the credit quality of such a series.

Intra- and inter-segment correlation

Scope assumes portfolio segments in granular auto ABS portfolios to be perfectly correlated, which simplifies the calculation of a portfolio's coefficient of variation. This calculation uses the coefficients of variation of the different portfolio segments.

Scope thus derives the correlation of the assets from the intra-segment default volatility. The vintage data for each segment of the portfolio reflects the assets' correlation to the extent that the period covered by vintage data contains sufficiently diverse scenarios.

Scope assesses whether the originator's vintage data adequately reflects asset correlation. For example (and ideally), if data includes periods of stress, and shows a significant deterioration in asset performance starting from a benign period, i.e. from pre-crisis to post-crisis.

Adjustments for seasoning (rebasing)

Vintage data demonstrates an asset's performance from origination to maturity and reveals the average effect of seasoning. Scope believes the shape of default vintage curves is explained not by the improving credit quality of underlying obligors, but by factors involved in its composition. Typical curves reflect: i) the compounding of survival rates; ii) the amortisation of the initial balance; iii) the expiration of contracts at maturity; and iv) the possible higher propensity of obligors to pay as equity accumulates under a contract. Additionally, the term structure of each series in a vintage set also captures the point in an economic cycle which may cause a pronounced front-loading of default rates.

Scope adjusts vintage data to capture the effect of seasoning on the assets which have been or will be transferred to the portfolio. This adjustment (rebasing) produces the marginal cumulative default rate that applies to the portfolio of assets transferred to the special purpose vehicle (as opposed to the lifetime default rate of the assets since origination).

The marginal contribution to the assets' lifetime default rate is referred to the surviving balance of the vintage at the seasoning point, i.e. the weighted average seasoning of the relevant portfolio segment. The balance at the seasoning point depends on the amortisations and defaults that have occurred between the contract's origination and the seasoning point.

An example of rebasing is illustrated below. The marginal default rate of 1.0% on the original balance at origination is effectively 1.5% when applied to the balance of surviving assets at the seasoning point. This marginal default rate is the lifetime default rate applicable to the securitised portfolio and differs to the original lifetime default rate of 4.8% at the time of the assets' origination.

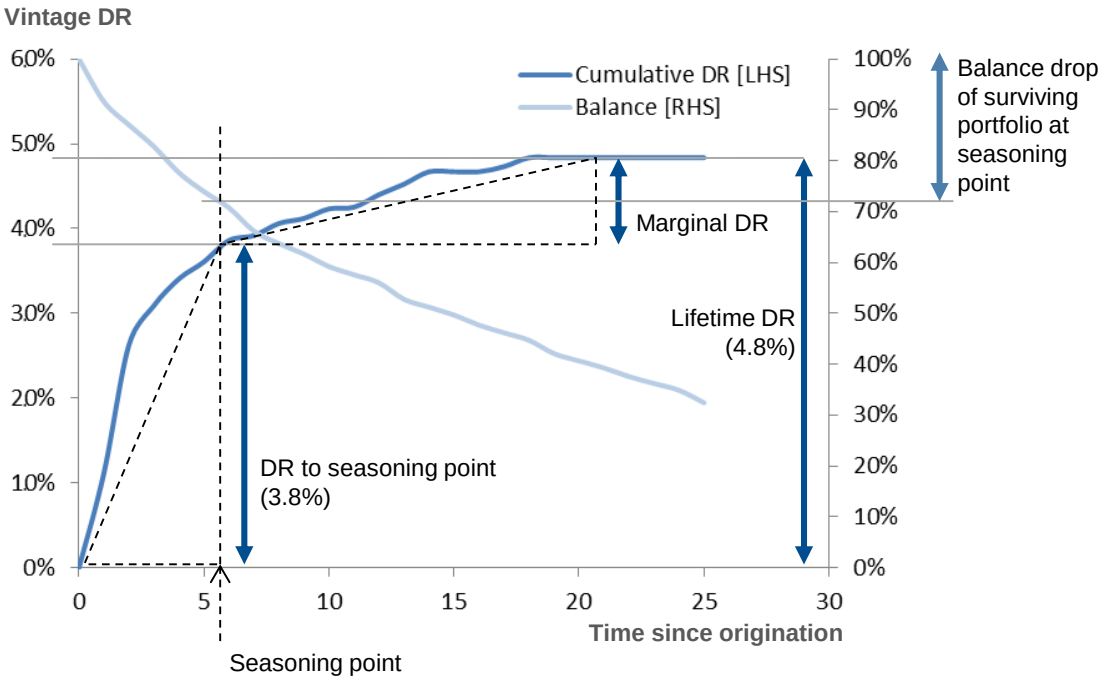
The rebasing is described by the following expression:

$$Rebased\ Marginal\ DR = \frac{Marginal\ DR\ from\ Seasoning\ Point}{1 - \ DR\ to\ Seasoning\ Point\ -\ Performing\ Balance\ Drop} = \frac{(4.8\% - 3.8\%)}{1 - \ 3.8\% \ - \ 28\%} = 1.5\%$$

The rebased marginal default rate can thus represent the percentage of the outstanding balance at the seasoning point that is larger than the original lifetime default rate as applicable to the original balance at origination.

The analysis of revolving portfolios considers the modified seasoning profile of the portfolio at the start of the amortisation phase.

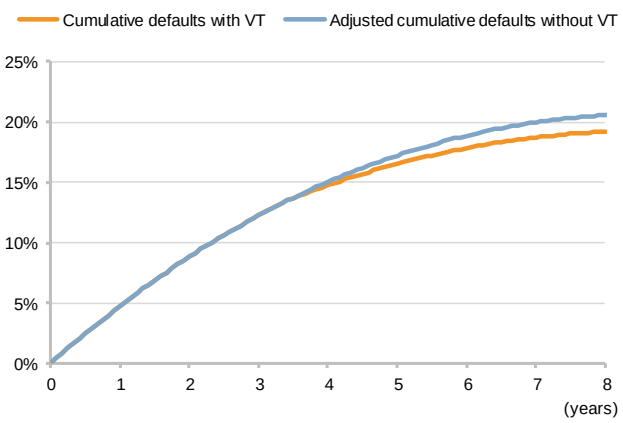
Figure 5. Rebasing marginal default rate from vintage analysis

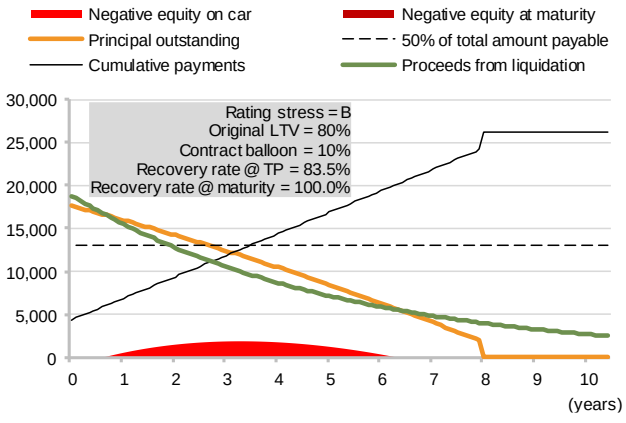


Adjustment for voluntary terminations

Scope adjusts the vintage data of portfolios exposed to voluntary termination (VT) to address whether voluntarily terminated contracts have been prepaid and cannot default, reducing the outstanding portfolio amount from the moment the vehicle is turned in. This effect is illustrated in Figure 6 where vehicle turn-in is possible after 3.5 years (the turn-in point, TP) and there is negative equity from the vehicle's depreciation over the life of the contract (but not at maturity, even though the contract features a final balloon payment after eight years). The adjustment considers the cumulative default rate up to the point of VT and then derives the implicit constant marginal default rate. The marginal default rate then enables us to rebuild the cumulative default curve for the stressed turn-in rates we apply when analysing the structure's cash flow.

Figure 6. The effect of vehicle turn-ins on vintage data after 3.5 years





Appendix II Assets exposed to vehicle-value risk

Residual value risk in loan or lease contracts

Vehicle-value risk results when the (residual) value of the vehicle is securitised, e.g. when the obligor can hand in the vehicle in lieu of final or all outstanding instalments, or the securitisation of liquidation proceeds from when the lessor sells the vehicle after the lease contract matures. The right to voluntarily terminate the contract by turning in the vehicle before maturity constitutes such vehicle-value risk. The issuer is exposed to losses if the vehicle cannot be sold in the market for an amount which covers the loan/lease outstanding balance plus liquidation expenses, or if the counterparty that guaranteed a minimum vehicle value defaults.

Key areas of consideration:

- Contract characteristics: i) irregular amortisation schedules (typically balloon payments and down payments on a vehicle); ii) residual value components; iii) voluntary termination options; and iv) reservation of title or vehicle ownership.
- Origination/commercial practices in setting contract residual values. Typically, the materiality of residual value risk depends on the amortisation terms of the contract and, particularly, the sizing of the final balloon payment in relation to the expected market value of a vehicle.
- Vehicle market value: i) fluctuations of market prices; ii) technological and design innovations; and iii) events related to the performance of the manufacturer.
- The credit quality of the guarantor if applicable.

Quantitative framework for contracts with vehicle-value risk

Figure 7 presents a 'tree' of possible default and vehicle turn-in events, which enables us to derive the expressions in Figure 8 and details how both credit risk and vehicle-value risk contribute to the portfolio's total expected loss.

This general framework is simplified when certain events are not possible under the terms and conditions of simpler contracts. For example, only two blocks are relevant when contracts are only exposed to credit risk: 'No loss' and 'Default'. When the option to voluntarily terminate a contract is zero (i.e. p{Turn-in} =0) or there is no option to pay in kind at maturity (i.e. p {Turn-in at maturity} =0) then the expected loss from elements (4) and (2) in the diagram, respectively, become zero.

Figure 7. Schematic view of sources of loss in vehicle-finance contracts

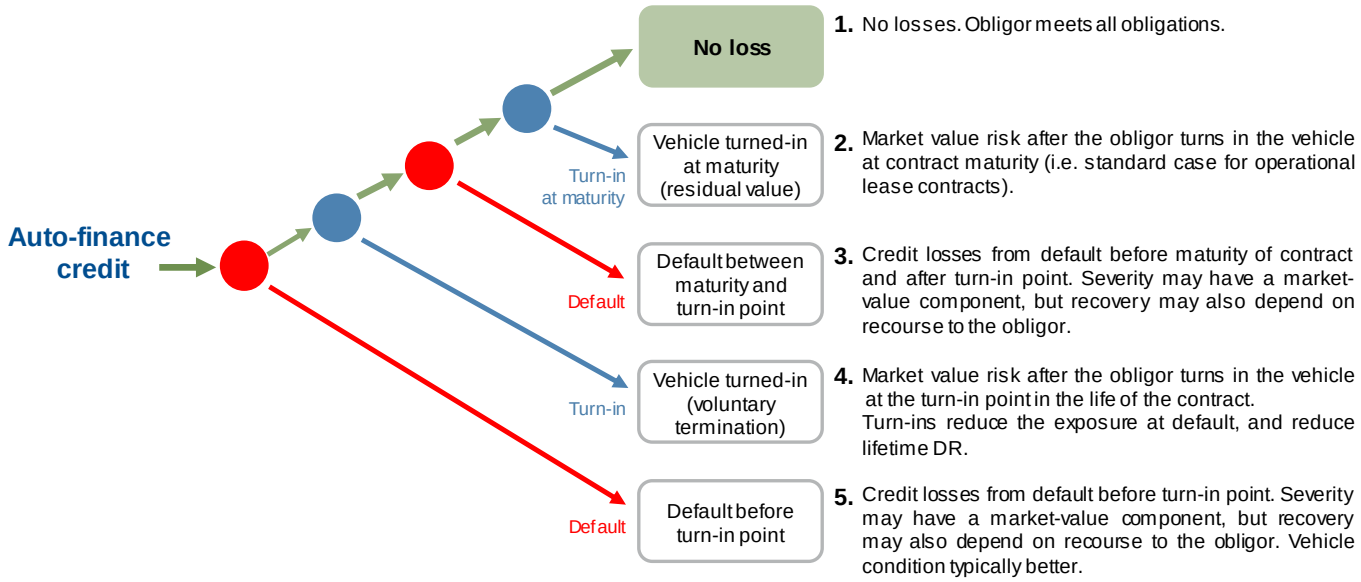


Figure 8. Contributions from portfolio to total expected loss

$$\Delta ExpectedLoss_1 = 0$$

$$\Delta ExpectedLoss_2 = (1 - DR_{TP}) \times (1 - p\{Turn\text{-}In\}) \times \left(1 - DR_{TP\text{-}Maturity}\right) \times p\{Turn\text{-}In_{Maturity}\} \times PF_{Maturity} \times \left(1 - RR_{fundamental@Maturity}\right)$$

$$\Delta ExpectedLoss_3 = (1 - DR_{TP}) \times (1 - p\{Turn\text{-}In\}) \times DR_{TP\text{-}Maturity} \times (1 - RR)$$

$$\Delta ExpectedLoss_4 = (1 - DR_{TP}) \times p\{Turn\text{-}In\} \times PF_{TP} \times \left(1 - RR_{fundamental@TP}\right)$$

$$\Delta ExpectedLoss_5 = DR_{TP} \times (1 - RR)$$

$$ExpectedLoss = \sum_{i=1}^{5} \Delta ExpectedLoss_i$$

where

- ΔExpectedLoss$_i$ are the contributions to the total expected loss from the portfolio of assets (ExpectedLoss);
- DR$_{TP}$ is the cumulative default rate from the contract's origination to the point of voluntary termination;
- p{Turn-in} is the probability of voluntary termination;
- DR$_{TP\text{-}Maturity}$ is the cumulative default rate from the point of voluntary termination to maturity;
- p{Turn-in$_{Maturity}$} is the probability of vehicle turn-in at maturity;
- PF$_{Maturity}$ is the portfolio factor at the point of voluntary termination;
- RR$_{fundamental}$ is the recovery rate calculated on the proceeds of liquidating the vehicle in the market at the time of voluntary termination;
- RR$_{fundamental@Maturity}$ is the recovery rate calculated on the proceeds of liquidating the vehicle in the market at maturity; and
- RR is the recovery rate from vintage analysis.

A numerical calculation of the contribution of losses from voluntary termination is illustrated in Appendix IV.

Voluntary termination risk

Voluntary termination occurs when the obligor has the contractual or statutory right to terminate the contract by turning in the vehicle before maturity, thus exposing the transaction to vehicle-value risk, which may result in value losses.

Scope factors the effect of voluntary termination or residual value into the analysis by incorporating the losses from the vehicle's liquidation into the expected loss computation. We determine the market value loss by comparing the stressed proceeds expected from the liquidation with the outstanding balance of the debt at the time the vehicle is turned in. Zero loss results when the liquidation proceeds exceed the balance of outstanding debt (i.e. in the case of full recovery when a vehicle is turned in).

Losses from vehicle turn-ins and portfolio defaults are inversely interdependent. This is because defaulting obligors cannot exercise the option to turn in the vehicle and terminate the contract; and when a contract is voluntarily terminated it fully amortises the exposure at the point of default and finishes credit risk.

With everything else being equal, the lifetime default rate of a transaction with the option to voluntarily terminate is lower than for those without this option. We account for the corresponding reduction in credit losses in our quantitative analysis when analysing the structure's cash flow.

Figure 9. Risks, risk drivers, implications and metrics of possible events in vehicle finance

Event	Risk	Driver	Implications	Relevant metrics
Obligor defaults before turn-in point	Credit	Ability or willingness of the obligor to pay	In general, dual recovery analysis (i.e. obligor and vehicle) Lower market value losses from turn-ins	• Cumulative default rate from vintage data at turn-in point • Recovery rate from vintage data

Event	Risk	Driver	Implications	Relevant metrics
Obligor turns in the vehicle after turn-in point but before scheduled maturity	Vehicle value	Option provided by contract or legal regime and obligor incentives	Pure vehicle-value risk and severity driven by stressed LTV Lower lifetime losses from credit	• Probability of voluntary termination • LTV at turn-in point
Obligor defaults after turn-in point	Credit	Ability or willingness of the obligor to pay	In general, dual recovery analysis (i.e. obligor and vehicle) Lower market value losses from turn-ins at maturity	• Cumulative default rate from vintage at turn-in point (possibly adjusted for vehicle turn-ins) • Recovery rate from vintage data
Obligor turns in the vehicle at maturity	Vehicle value	Option provided by contract or legal regime and obligor incentives	Pure vehicle-value risk and severity driven by stressed LTV	• Probability of vehicle turn-in at maturity • LTV at maturity

Analytical implications

Adjustment of default rates after vehicle turn-in

Vintage data exhibiting the option to turn in a vehicle reflects the reduced lifetime default rate which results from early voluntary terminations. In our analysis, we decouple defaults from turn-ins so we can apply independent stresses to both defaults and the probability of vehicle turn-ins.

Vehicle-value risk

Losses from vehicle-value risk add to losses from credit. We incorporate such losses into our analysis during the cash flow analysis, given the dependency between portfolio defaults and the probability of a voluntary termination or a turn-in at maturity.

Level of turn-ins

Key inputs to this part of the analysis are the mean probability of voluntary termination (i.e. the historical average of vehicle turn-in frequencies) and the mean probability of turning in the vehicle at maturity (i.e. the historical average frequency of terminating a contract with a payment in kind). We also analyse the volatility of such historical frequencies, in addition to the historical means, to derive the probabilities to be considered under stress.

We stress the mean probability assumptions by applying rating-conditional stresses (see Figure 10) to derive rating-conditional assumptions for the analysis. For example, we will consider a probability of voluntary termination under a AAA rating-conditional stress which equates to the historical mean frequency plus double the standard deviation of the historical frequency of voluntary terminations.

Figure 10. Rating-conditional stresses on the probability of vehicle turn-in

(Number of standard deviations)	B	BB	BBB	A	AA	AAA
At voluntary termination point	0.0	0.4	0.8	1.2	1.6	2.0
At contract maturity	0.0	0.4	0.8	1.2	1.6	2.0

Appendix III Severity of vehicle turn-in on voluntary termination or at maturity

Scope analyses the severity upon voluntary termination or turn-in at maturity by comparing the outstanding credit exposure on the loan or the leasing contract with the proceeds expected from a vehicle's liquidation. Consequently, the following two steps are involved: i) estimating the proceeds from a vehicle's liquidation under stress; and ii) finding the implied fundamental recovery rate achievable from using such liquidation proceeds only.

We would reduce the severity and consider the standard recovery assumption on any marginal claim above the liquidation value of a vehicle if the obligor must cover any shortfall after turning in the vehicle. This would have to be clearly shown in the terms of the contract, and we expect that the legal opinion supports the assumption that the issuer would have a claim on the obligor for the shortfall.

The following sections explain the calculation of vehicle values and the fundamental recovery rates after a vehicle turn-in. We provide examples for calculating the fundamental recovery upon a turn-in at maturity. The calculation of the fundamental recovery rate upon voluntary termination follows the same steps, but only considers the exposure and the proceeds from the vehicle value at the voluntary-termination turn-in point.

Fundamental recovery rates do not depend on the default scenario being considered, and are rating-conditional because they embed increasing levels of stress as the target rating rises (i.e. the higher the rating, the harsher the vehicle-value decline and the higher the probability of vehicle turn-in).

Proceeds from liquidation of vehicles

Scope determines the potential loss from a vehicle's liquidation by estimating the proceeds which can be obtained from selling used cars under rating-conditional stress. We estimate the value of the vehicle by applying a cascaded series of rating-conditional vehicle-value stresses to the original value of the vehicle: i) depreciation value adjustment from normal ageing as a function of time; ii) additional vehicle-value haircut for the below-average condition revealed by the obligor's motivation to turn-in (i.e. the turn-in value haircut, *TurnInVH*); and iii) liquidation costs. The resulting credited car value is shown in expressions (1) – (3) and is equal to the proceeds we expect from the liquidation under stress.

(1) $Credited\ car\ value\ or\ liquidation\ proceeds|^{Rating}(time) =$

$$= Original\ Value \times Adjustment|^{Rating}_{ageing}(time) \times Adjustment|^{Rating}_{condition} \times (1 - Liquidation\ Cost)$$

where

(2) $Adjustment|^{Rating}_{aging}(time) = Rating\text{-}conditional\ value\ haircut\ multiplier\ from\ aging\ as\ a\ function\ of\ time =$

$$= \left(1 - Monthly\ MVD|^{Base\ case} * \left(1 + Monthly\ MVD\ stress|^{Rating}\right)\right)^{time\ in\ months}$$

(3) $Adjustment|^{Rating}_{condition} = Rating\text{-}conditional\ value\ haircut\ multiplier\ from\ condition\ at\ turn\text{-}in =$

$$= \left(1 - TurnInVH|^{Rating}_{condition}\right) =$$

$$= \left(1 - TurnInVH|^{Base\ case}_{condition} \times TurnInVH\ Multiple|^{Rating}\right)$$

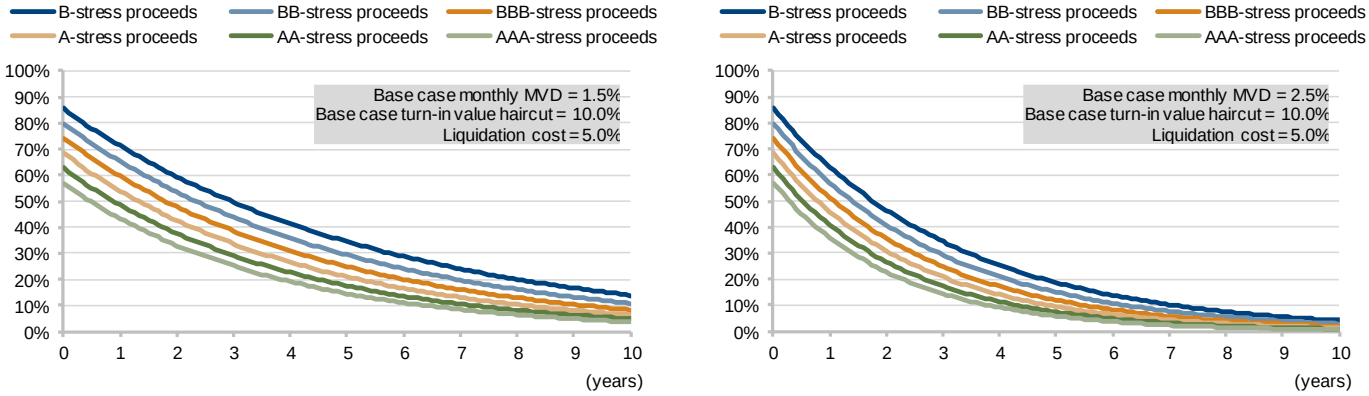
A numerical calculation is illustrated in Appendix IV.

Figure 11. Stresses related to calculating losses from vehicle-value loss

	B	BB	BBB	A	AA	AAA
Monthly market-value-decline stress	0%	10%	20%	30%	40%	50%
Turn-in value-haircut multiple	1.0	1.6	2.2	2.8	3.4	4.0

The vehicle-value haircut upon turn-in and the vehicle liquidation costs are transaction-specific assumptions because they depend on the best practices and processes of the originator. Scope derives these assumptions from the information provided by the originator.

Figure 12. Credited proceeds from car values under different rating stresses (under 1.5% and 2.5% base case monthly vehicle-value declines, respectively)



Fundamental recovery rate from car liquidation proceeds

Scope takes the exposure at default at either the turn-in point or at maturity and compares this balance with the proceeds from vehicle liquidation as calculated in the previous step. The recovery rates are rating-conditional because the liquidation proceeds depend on the rating stresses applied when valuing the vehicle. The recovery rates are calculated as described in expression (4).

(4) $$Fundamental\ recovery\ rate|^{Rating}(time) = min\left\{100\%, \frac{Credited\ car\ value|^{Rating}(time)}{Outstanding\ balance(time)}\right\}$$

The fundamental recovery rate is 100% if the proceeds from the vehicle's liquidation are enough to cover the outstanding balance on the loan at either the moment of voluntary termination or at maturity.

A numerical calculation is illustrated in Appendix IV.

Appendix IV Numerical example of vehicle loss calculations

This appendix illustrates the calculation of losses from vehicle-value risk with simple numerical examples.

Calculation of proceeds from vehicle liquidation

In this example, we assume that the average vehicle in the portfolio has an original value of EUR22,000 with an expected monthly market value decline of 1.6%. The expected average age of a vehicle to be liquidated after it is turned in when the contract matures is five years. Further, we expect an additional value decline of 10% from the below-average condition of the vehicles whose owners decide to turn them in rather than keep them, and liquidation costs of 5%.

The proceeds that we expect will be available from the liquidation of the vehicle to cancel outstanding debt at maturity are:

$$Proceeds|_{Rating} =$$

$$= Value\ new \times \left(1 - MVVD \times \left(1 + MVVDstress|_{Rating}\right)\right)^{Age\ in\ months} \times \left(1 - AVVD \times AVVDstress|_{Rating}\right) \times (1 - Costs)$$

Under a B stress:

$$\text{Proceeds}|_{B} =$$

$$= \text{EUR } 22{,}000 \times \left(1 - 1.6\% \times (1 + 0\%)\right)^{(5\times 12)} \times (1 - 10\% \times 1.0) \times (1 - 5\%)$$

And under a AAA rating-conditional stress the monthly market value decline increases to 50% and the value haircut because of condition is multiplied by four:

$$\text{Proceeds}|_{AAA} =$$

$$= \text{EUR } 22{,}000 \times \left(1 - 1.6\% \times (1 + 50\%)\right)^{(5\times 12)} \times (1 - 10\% \times 4.0) \times (1 - 5\%)$$

Calculation of rating-conditional fundamental recovery rates

We now assume a financing contract where vehicles are sold with a down payment of 20% (i.e. the original LTV is 80%) and where there is a termination payment at maturity (i.e. balloon payment) of 20% of the original loan balance after five years. Such a contract has a weighted average life of 3.15 years, and the voluntary termination point would be 2.42 years after origination, equivalent to cash-weighted-average time of 1.28 years.

The fundamental recovery rates under B and AAA rating stresses are the following:

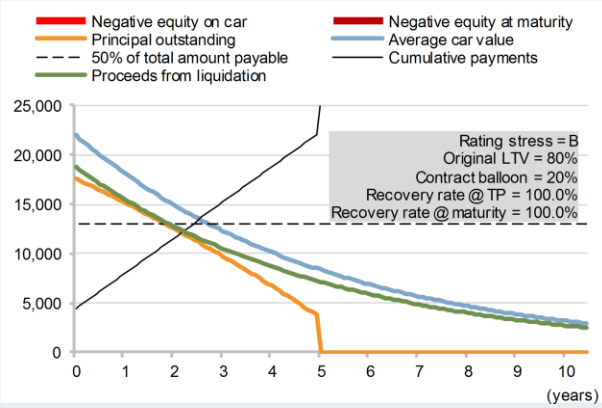
$$Fundamental\ recovery\ rate|^{B}(5\ years) = min\left\{100\%, \frac{\text{Proceeds}|_{B}^{\square}(5\ yr)}{Outstanding\ balance(5\ yr)}\right\} = min\left\{100\%, \frac{EUR\ 7{,}146.5}{EUR\ 3{,}520}\right\} =$$

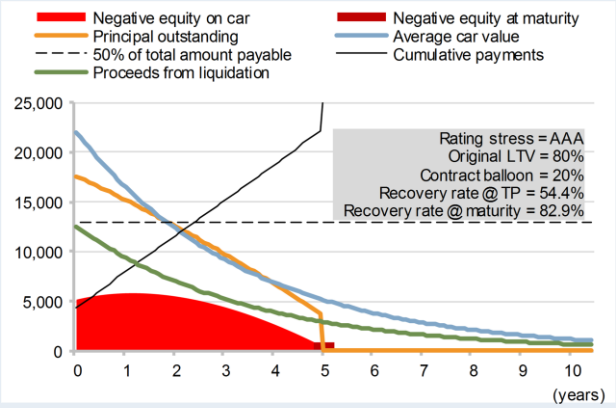
$$= 100\%$$

$$Fundamental\ recovery\ rate|^{AAA}(5\ years) = min\left\{100\%, \frac{\text{Proceeds}|_{AAA}^{\square}(5\ yr)}{Outstanding\ balance(5\ yr)}\right\} = min\left\{100\%, \frac{EUR\ 2{,}919.4}{EUR\ 3{,}520}\right\} =$$

$$= 82.9\%$$

This is illustrated in the following figures. The proceeds from liquidation are enough to cover the outstanding balance at the contract's maturity under the B rating stress and thus the recovery is 100%. Yet the recovery under the AAA rating stress is just 82.9% because the proceeds from liquidation are less than the balloon payment.





Calculation of losses from vehicle-value risk at voluntary termination point

The fundamental recovery rate in a AAA stress scenario is 54.4% when calculated as in the previous example at the voluntary termination point (i.e. 2.4 years after closing; bullet-equivalent to 1.28 years). The amortisation factor at the turn-in point is 64.8%.

For this example, we assume historical frequencies of voluntary termination with a mean of 5% and a standard deviation of 5%. We also assume a rating-conditional stress of two standard deviations in AAA scenarios, which result in a AAA probability of voluntary termination of 15% = 5% + 2 x 5%.

We assume in this example a portfolio with lifetime portfolio defaults of 15%. It is important to remember that Scope's cash flow analysis considers all portfolio default rates from 0% to 100%. This example illustrates the calculation for just one default rate case.

The constant marginal default rate is calculated as follows, considering the weighted average life:

$$\mathrm{DR}_{1year} = 1 - \left(1 - DR_{lifetime}\right)^{\left(\frac{1}{WAL}\right)} = 1 - (1 - 15\%)^{\left(\frac{1}{3.15}\right)} = 5.03\%$$

The cumulative default rate up to the voluntary termination turn-in point is calculated as follows (notice that the weighted average time to the voluntary termination point is used, as implicit in the formula, the exposure is constant):

$$\mathrm{DR}_{turn-in\ point} = 1 - \left(1 - DR_{1year}\right)^{(WA\ turn-in\ point\ time)} = 1 - (1 - 5.03\%)^{(1.28)} = 6.4\%$$

Finally, the losses from vehicle-value risk can be calculated as described in the methodology:

$$Loss\ from\ vehicle\ value\ risk|_{\square}^{AAA}\left(DR_{lifetime} = 15\%\right) =$$
$$= (1 - DR_{TP}) \times p\{Turn\text{-}In\}|_{\square}^{AAA} \times PF_{TP} \times \left(1 - RR_{fundamental@TP}|_{\square}^{AAA}\right) =$$
$$= (1 - 6.4\%) \times 15\% \times 64.8\% \times (1 - 54.4\%) = 4.15\%$$

The result indicates that 4.15% of the initial portfolio balance is expected to be lost through vehicle-value losses from voluntary termination when the portfolio lifetime default rate is 15%.

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