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Draft: Rating Residual Value Insurance

Residual value insurance (RVI) indemnifies an insured against a loss that might occur if the sale proceeds of a physical asset that meets predefined return conditions at a predefined date are less than the asset's insured residual value (attachment point).

Companies that underwrite RVI are fundamentally insurance companies, therefore *Best's Credit Rating Methodology (BCRM)* remains the governing document that provides a comprehensive explanation of A.M. Best's general rating process, including the complete set of rating criteria employed in the rating. This criteria report highlights rating considerations unique to the evaluation of an RVI book of business – specifically, the calculation of loss-reserve risk and premium written risk, which depends heavily on the quality of the insured assets.

Brief Introduction to RVI

RVI mitigates the risk of an unforeseen decline in the value of a physical asset. Corporations, equipment manufacturers, financial institutions, asset managers and special-purpose entities use RVI to transfer the risk of asset diminution. By transferring this risk, the owner, investor or financier of an asset can structure transactions to reduce the cost of financing, enhance yield, improve liquidity, expand market distribution, and receive favorable tax and accounting treatment.

The predefined date is usually on maturity or break of a lease of the physical asset, or when a balloon payment is due.

It generally is accepted that RVI originated in the aviation industry, where it has been used successfully to insure the values of aircraft at the end of leases.

Common uses of RVI are as follows:

1. **FASB 13 Tax Accounting:** RVI can be used to convert operating leases to finance leases for favorable accounting treatment under FASB 13.

2. **Lease Securitizations:** Using RVI, lessors can facilitate a securitization of their leases efficiently on the public and private markets by converting the residual value risk into a rated credit risk of the third-party insurer.

3. **Balloon-Note Financing:** When introduced in the early stage of the financing deal, RVI can improve loan-to-value ratios and mitigate the lender's exposure to residual value risk at the maturity of the financing; thus the RVI facilitates and/or expands funding sources, or makes previously uneconomic transactions viable.

Physical assets that are most commonly financed with RVI are aircraft, marine vessels, personal vehicles (automobiles, trucks), commercial equipment (special machinery, construction equipment), rail equipment (locomotives, rail cars, containers) and commercial real estate. Most of these assets have a long economic life, low probability of technological obsolescence and well-developed secondary markets, albeit with limited liquidity.

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Historically, RVI has incurred significant losses and may not currently be available for a wide variety of assets. This is likely due to the difficulty of forecasting future residual values for most asset classes besides private passenger vehicles, for which residual value data are robust.

The Special Nature of RVI Loss-Reserve Risk

Historical loss-ratio data associated with multiple lines of insurance business drive the capital factors in the Best's Capital Adequacy Ratio (BCAR) model that determine the capital charges for the underwriting risk components it addresses. Required capital for loss-reserve risk is generated by applying reserve capital factors to an insurer's adjusted loss reserves (after adjusting for A.M. Best's view of the insurer's reserve adequacy). Similarly, required capital for premium written risk is generated by applying premium capital factors to an insurer's net premiums written.

However, estimating loss-reserve risk and premium written risk of an RVI book – particularly the amount of capital to be held to withstand losses within a specific confidence level – requires evaluating the loss distribution of the specific risks underwritten by the RVI insurer. Unlike conventional insurance, such as life, health, property and casualty, where insured risks tend to be independent, RVI risk is correlated across insured assets (as explained in the next section). A.M. Best expects the loss distribution associated with such risks to be positively skewed with considerable tail risk. As the risk profiles of the assets covered in RVI are substantially diverse, the process involves performing Monte Carlo simulations to produce the aggregate loss profile of the RVI book and translating such a profile into claims against the RVI insurer. This simulation process fundamentally requires a review of the assets' risks; the assumed pair-wise correlations among various assets being insured; and the structure of the RVI policies.

The Analytical Framework of an RVI Portfolio

Physical assets in an RVI book of business can vary from a few jumbo jets to hundreds of thousands of passenger vehicles. Each asset has its specific operating environment and economic risk. However, in constructing an analytical framework to evaluate their risks, the assets do share some commonalities, since they are all physical assets. It is not possible to address all the assets RVI can cover. Therefore, the rest of this document will use specific assets such as aircraft and marine vessels to illustrate some of the major concepts in the construction of an analytical framework for evaluating residual value risk. Regardless of the asset, the main idea is that a residual value insurer must be able to predict the future value of an asset within a given confidence level by considering such items as the asset's economic life, depreciation, scrap value and other factors.

Depreciation

Since most physical assets have limited economic life, their values depreciate over time. Aircraft, as an example, depreciate for at least two reasons: (1) An aircraft ages and deteriorates physically over time. Components will require progressively more maintenance as they age, with an associated increase in the cost of labor, parts and down time. (2) Old aircraft models eventually face increased competition from more modern and efficient models featuring improvements in technology and performance.

Based on industry analysis, two-thirds of an aircraft's underlying value retention correlates directly with its age. The remaining value retention is linked to its remaining economic life and the forecasted returns it will generate over this period, which primarily depends on the future economic environment.

Because there is wide variation in the physical and economic characteristics of aircraft,

the rate of depreciation will depend on model type. In addition, the rate of depreciation is unlikely to be constant; value may decline more rapidly at the beginning or end of an aircraft's economic life.

Base Value & Market Value

The term "base value" is used in the aircraft market to represent a "through-the-cycle" value. This value is not affected by imbalances in supply and demand of business cycles, nor by short-term events that temporarily alter values such as fluctuations in fuel costs, war or recessions. It assumes an aircraft's maintenance status is at half-life (see *Maintenance* for a detailed explanation). Base value is similar to expected value.

Base value is hypothetical but is necessary to understand the volatility of market value, which represents the most likely trading price of an asset under market and economic conditions.

Cyclical Swing

In general, cyclical swing is the major volatility component around base value because of the imbalance of supply and demand in the business cycle. To illustrate cyclical swing in action, data from 1976 to 2010 show that the price of a 5-year-old Panamax dry bulk carrier exhibited market values varying from 35% to 300% of the mean value of USD 32.7 million (in December 2011 dollars). This shows the level of volatility and cyclicality in the dry bulk shipping industry, which is affected by the variability in earnings, investment and return on capital. This boom-and-bust cycle is not restricted to the dry bulk shipping industry but is common in other types of ships (VLCC, Suezmax, Aframax, etc.) and other asset classes, such as aircraft and commercial real estate.

The history of aviation is replete with cycles that more or less reflect world economic conditions, as measured by gross domestic product (GDP) or precipitated by exogenous factors such as wars, terrorism, fuel costs and other conditions. The driving forces of this cyclical swing are world and regional growth in GDP and overly aggressive investment during booms, complicated by long lead time to manufacture assets.

Inflation

Inflation plays an important role in determining the market value of physical assets, especially those with a long economic life, such as vessels and aircraft. All else being equal, a higher inflation rate will result in a higher market value. Since the majority of aircraft and marine vessel sales are in U.S. dollars, the U.S. inflation rate has the greatest effect on the value of these asset classes.

Maintenance

Most physical assets with a long expected economic life require considerable maintenance. The consequence of an inadequately maintained asset is a shorter economic life, which reduces its value. This is especially true for aircraft. An important part of the value of an aircraft is its maintenance status. The wide disparity between appraisals for similarly aged aircraft often can be explained by differences in their maintenance condition. Appraisers, in estimating the market value of an aircraft, use two industry-standard terms to represent an aircraft's maintenance status as a baseline reference:

1. **Full-life status** implies that each major maintenance event fully restores the asset to zero time condition.

2. **Half-life status** assumes that the airframe, engines, landing gear and all major components are half-way between major overhauls and that any life-limited part (for example an engine disk) has used up half of its life.

Liquidity

Liquidity is a measure of how easy it is to convert assets to cash. More liquid assets tend to retain more value. In estimating the base value of an aircraft, appraisers will look at liquidity factors such as the number of planes in service and on order; the number of operators; the backlog of orders; the breadth of the manufacturer's product line; and other factors. The liquidity factors of the aircraft depend largely on:

1. Model Type
   To illustrate the variability in market values of aircraft based on model types, A.M. Best observed market values of a variety of aircraft manufactured in 2001 as a percentage of their original base value after 10 years of service. The observed percentage ranged from 23% for the relatively illiquid Boeing 747-400 to 56% for the more liquid Boeing 737-800. All else being equal, narrow-body aircraft models typically are considered slightly more liquid than wide-body models. In addition, a more liquid aircraft such as the Boeing 737-800 is less sensitive to cyclical swings than the relatively illiquid DC-10-30ER.

2. Delivery Time Relative to Production Cycle
   In general, early-phase and final-phase production units tend to have lower residual values. This is especially true for capital-intensive assets such as aircraft and marine vessels. For example, aircraft in the early stage of production as compared with the mid-stage of production tend to 1) be heavier because of advances in material science, 2) have lower thrust, 3) have lower gross weight and 4) have higher direct operating costs. Thus value retention of aircraft built in the early stage of the production cycle is low compared with those produced in the mid-stage of the production cycle. Aircraft manufactured at the tail end of their production cycles are competing against aircraft with newer technology that are generally more efficient, the older designs therefore tend to experience higher declines in values. Aircraft models that are still in production tend to retain their values and lease rates to a greater degree than those that are no longer in production. The cyclical variation in values for in-production aircraft is more stable than for out-of-production aircraft, whose values tend to be much more volatile over time.

Correlation

1. Correlation Among Different Asset Classes
   The physical assets that are most commonly financed with RVI are either capital goods, such as marine vessels, or consumer goods, such as private passenger vehicles. Their market prices are driven mainly by the world economy (as is the case with aircraft) and/or the regional economy (as is the case with commercial real estate). For example, more than 90% of world trade is carried by the international shipping industry. There is a strong relationship between the cost of shipping (and thus market value of shipping vessels) and the strength of the world economy, which is represented by the global GDP. Similarly, in aviation, air passenger miles and global GDP correlate strongly. For example, the correlation between air passenger miles and the world's GDP is 0.99 using time-series world aggregate data from 1970 to 2005. Therefore, it is not surprising that the shipping and aviation industries are highly correlated.

2. Correlation Among Different Model Types Within the Same Asset Class
   Although cyclical swings in market value of aircraft vary in relative amplitude by model type, their frequencies almost always correlate in time. That is, events affecting individual aircraft values are linked; the values of all aircraft will tend to go up at times when air passenger traffic increases and airline profits are strong, and vice versa.

Future Base Value Curve

The future base value curve is the best estimate of the expected depreciation value at various times as an asset ages. The curve generally is derived by extrapolating from the base value to the future. Like the base value, the future base value curve assumes no imbalance in supply and demand. The keys in estimating the future base value curve are:

1. The selection of an appropriate depreciation rate;

2. The expected economic life, which is subject to variations in maintenance and operating conditions; and

3. Scrap value.

The future base value curve is used to calculate the future market value paths of the RVI assets, as discussed in the next section.

Simulation of Future Market Value Paths

The future base value curve is a critical component in the analytical framework because it is used to calculate the future market value of the assets in an RVI portfolio. The process for deriving the future market value of an asset from its future base value curve begins with adjusting the curve for the effect the production cycle has on liquidity as discussed earlier. Volatility and inflation assumptions then are imposed on this newly formulated future base value curve to create the many future market value paths in nominal dollars through a simulation process. These paths then are used in calculating RVI claims as further described in the section below titled **Monte Carlo Simulation of RVI Claims**.

Documentation/Data

To the extent available, A.M. Best expects an RVI insurer to provide, by asset type and model type, 1) historical pricing data for volatility and correlation estimation; and 2) the future base value curve of assets covered by the RVI policies. The reliability of historical data from highest (most reliable) to lowest are as follows: 1) latest historical market values and/or price data covering several business cycles: 2) latest historical market values and/or price data covering at least one business cycle. Where transactions have attached conditions or considerations that may affect the market value of assets (i.e., attached lease or time charters, guarantee support), careful consideration must be given to adjusting the value to represent the competitive price achievable in the market without the attached conditions. In the situation that historical market values and/or price data is not readily available, A.M. Best may rely on substitute data or make conservative assumptions in addition to the review of the insurer's underwriting practice.

Monte Carlo Simulation of RVI Claims

A.M. Best uses the nomenclature "net claims" to indicate the amount of loss the RVI insurer has to pay each period. RVI net claims can be calculated by comparing the RVI attachment point and the multiple paths of market values discussed earlier. Net claims is the excess, if any, of the RVI attachment point over market values in nominal dollars.

A.M. Best discounts the net claims to recognize the equity built into such claims. The discount rate in present-value calculation is 4%, which is consistent with the discount rate used in A.M. Best's rating criteria, including *Understanding BCAR for U.S. Property/Casualty Insurers*.

Exhibit 1

Best's Idealized Default Rates of Insurers*

1-year default rates on the credit market scale.

Rating	Default Probability (%)
aaa	0.0341
aa+	0.0636
aa	0.1129
aa-	0.1623
a+	0.2116
a	0.2310
a-	0.2697
bbb+	0.6708
bbb	1.2018
bbb-	2.2956

* Derived from *Best's Idealized Default Matrix*

A.M. Best's Monte Carlo simulation model calculates the present value of total net claims (PV of net claims) against an RVI insurer on a portfolio basis. A.M. Best then chooses the appropriate PV of net claims from an array of simulated PV of net claims – such that the probability of exceeding such PV of net claims is no more than the one-year default probability shown in **Exhibit 1** for the targeted rating level – to be equal to the adjusted loss reserves. For an "aaa" rating target, the default threshold is 0.0341% over a one-year period. The effective confidence level is approximately 99.97%. A.M. Best uses this confidence level approach because A.M. Best expects the PV of net claims distribution to be positively skewed, with considerable tail risk due to strong correlations 1) among different asset classes and 2) among model types within the same asset class.

A.M. Best uses the same approach to determine the adjusted premium capital factor for net written premiums. To calculate this adjusted premium capital factor, A.M. Best uses one year's originations as the representative portfolio. Given this representative portfolio, A.M. Best then calculates the premium capital factor as the ratio of the representative portfolio's modeled PV of net claims at the selected threshold to the representative portfolio's net written premiums.

BCAR Results & Adjustments

The adjusted loss reserves and adjusted premium capital factor as described in the prior section are used in A.M. Best's BCAR model to determine the ratio of an RVI insurer's adjusted capital to its net required capital. As illustrated in **Exhibit 2**, the adjusted loss reserves are labeled as component B5 and the adjusted premium capital factor is used in the determination of component B6. The criteria report *Understanding BCAR for U.S. Property/Casualty Insurers* explains fully the significance of the BCAR score and how it reflects just one aspect of an insurer's financial strength rating.

Collectively, the investment, credit and underwriting risk components generate more than 99% of a company's gross required capital. This figure, which is the sum of capital required to support all risk components, reflects the amount of capital needed to support all of those risks if they were to develop simultaneously. However, these individual components then are subjected to a covariance calculation within the BCAR formula to account for their assumed statistical independence. This covariance adjustment signals that it is unlikely that all of the individual risk components will develop simultaneously, and this adjustment generally reduces a company's overall required capital. However, in certain instances, A.M. Best will modify

Exhibit 2
Structural Overview: A.M. Best's Capital Adequacy Ratio

$$\text{BCAR} = \frac{\text{Adjusted Surplus}}{\text{Net Required Capital}}$$

Adjusted Surplus Components	Net Required Capital (NRC) Components
Reported Surplus	(B1) Fixed-Income Securities
Equity Adjustments:	(B2) Equity Securities
Unearned Premiums	(B3) Interest Rate
Assets	(B4) Credit
Loss Reserves	(B5) Loss and LAE Reserves
Reinsurance	(B6) Net Written Premium
Debt Adjustments:	(B7) Off Balance Sheet
Surplus Notes	
Debt Service Requirements	
Other Adjustments:	**Covariance**
Potential Catastrophe Losses	
Future Operating Losses	$NRC = \sqrt{(1-X^2)*(B1)^2+(1-Y^2)*(B2)^2+(1-Z^2)*(B3)^2+(0.5*B4)^2+[(X*B1)+(Y*B2)+(Z*B3)+(0.5*B4)+B5]^2+(B6)^2+(B7)}$

Source: A.M. Best. Co.

elements of the covariance adjustment to reflect some level of correlation among some of the components. With respect to RVI insurers, A.M. Best is aware that such entities may invest in assets that are correlated to assets they insure. From a risk management point of view, this could mean that the aggregate loss experienced by the RVI insurer due to claims on the assets it has insured could be correlated with the market risk and default risk of all or a portion of the assets in its investment portfolio. In such instances, A.M. Best will adjust the parameters X, Y, Z in the covariance adjustment formula in **Exhibit 2** to reflect the correlations between corresponding asset risks and reserve risks. Please see *Understanding BCAR for U.S. Property/Casualty Insurers* for the detail of the covariance adjustment.

Conclusion

Although insurers underwriting RVI are analyzed like other property/casualty (P/C) companies, the unique characteristic of RVI portfolios require additional analysis of loss-reserve risk and premium written risk utilizing the Monte Carlo simulation method. This criteria report highlights major considerations in the analysis that is performed beyond that of a typical P/C writer.

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