Selling Aviation Debt Securities to EU Insurance Undertakings

A salesperson's dream or not?

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2 Abbreviations and Assumptions

ABS, Asset Backed Security

ALM, Asset Liability Management

APU, Auxiliary Power Unit

BSCR, Basic Solvency Capital Requirement

DSCR, Debt Service Coverage Ratio

ECA, Export Credit Agency

ECAI, External Credit Assessment Institution

EEA, European Economic Area

ETC, Equipment Trust Certificate

EETC, Enhanced Equipment Trust Certificate

ESG, Environmental, Social, and Governance

ETC, Equipment Trust Certificate

EIOPA, European Insurance and Occupational Pensions Authority

ETC, Equipment Trust Certificate

EU, European Union

EUR, Euro

FX, Foreign Exchange

IDERA, Irrevocable De-registration and Export Request Authorisation

IRR, Internal Rate of Return

KBRA, Kroll Bond Rating Agency

LTV, Loan to Value

MAC, Material Adverse Change

MPR, Minimum Premium Rate

OECD, Organization for Economic Cooperation and Development

ORSA, Own Risk and Solvency Assessment

p. a., per annum

QIB, Qualified Institutional Buyer

RPK, Revenue Passenger Kilometres

SCR, Solvency Capital Requirement

SPV, Special Purpose Vehicle

S&P, Standard & Poor's

U.K., United Kingdom of Great Britain and Northern Ireland

U.S., United States of America

USD, U.S. Dollar

WAL, Weighted Average Life

Throughout the paper, unless otherwise specified, the term *insurance undertaking* is used to refer to life insurance companies, non-life insurance companies, and reinsurance companies which are domiciled in the Eurozone and regulated by the national competent authority of an EU Member State.

Assumptions

The paper limits its scope by assuming that insurance undertakings calculate their solvency capital requirements ("SCR") using the Solvency II "standard formula". All estimates of the components of the market-risk SCR in the standard formula are: (i) based on the authors' interpretation of the Solvency II Delegated Acts published in October 2014; (ii) before diversification benefits; and (iii) gross of any loss absorbing effects.

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4 Executive Summary

The paper is written from two perspectives:

(i) To provide actuaries interested in wider fields with an overview of the principal types of aviation debt securities available, including the nature of the potential risks and returns from investing in such securities; and

(ii) To provide the issuers of aviation debt securities, mainly airlines and aircraft lessors, with an overview of the issues likely to be considered by insurance undertakings when assessing aviation debt securities as a potential asset for their portfolio.

In relation to the latter perspective, the authors would welcome feedback from members of the Society of Actuaries in Ireland.

The paper seeks to address four major questions in relation to insurance undertakings investing in aviation debt securities:

1. Why invest in aviation debt securities?
2. What are the main types of aviation debt securities that are available for investment?
3. What are the key challenges facing insurance undertakings when investing in aviation debt securities?
4. How does one analyse an aviation debt security?

4.1 Why invest in aviation debt securities?

The principal reason why insurance undertakings might invest in aviation debt securities is the attractive yield that they offer relative to other asset-backed securities. A significant amount of aviation debt securities tends to be issued by special purpose vehicles ("SPVs") or trusts which are not involved in any other business and have no other debt. Further, there is a strong secondary market for the collateral underlying the SPVs, aircraft and aircraft engines, which reduces the risk for investors.

4.2 What are the main types of aviation debt securities that are available for investment?

In terms of risk and reward, the aviation debt securities market offers a full spectrum of credit risk from AAA rated debt through, secured debt, subordinated secured debt, and unsecured debt to mezzanine finance.

The lowest risk end of the spectrum offers debt securities guaranteed by the export credit agencies ("ECAs") of highly-rated sovereigns such as Germany, France, the United Kingdom ("U.K.") and the United States of America ("U.S.").

Moving further up the risk scale, there are debt securities which represent secured lending to an SPV which owns one or more aircraft and under which the lender has taken security over the aircraft and the aircraft lease receivables. The servicing of the SPV is outsourced to an aircraft lessor or other entity with significant aviation collateral management experience. An

Enhanced Equipment Trust Certificate ("EETC") and the Class A bonds of an aviation asset backed security ("ABS") are examples of such secured debt securities.

Nearing the top of the risk scale, there are debt securities which represent unsecured lending to airlines and aircraft lessors and Class C bonds of an aviation ABS which are a form of mezzanine finance.

4.3 What are the key challenges facing insurance undertakings when investing in aviation debt securities?

For Eurozone domiciled and EU regulated insurance undertakings, the challenges of investing in aviation debt securities fall under several headings including:

- The amount of SCR required in respect of market risk;
- Liquidity;
- Potential yield;
- Asset-liability matching;
- Credit risk;
- Currency risk;
- Interest rate risk;
- Complexity of aircraft collateral; and
- Implications for IFRS financial statements.

Of the above, liquidity and the amount of the SCR arising from holding aviation debt securities are likely to be the biggest challenges facing insurance undertakings.

The sub-modules of the market risk SCR, $SCR_{MARKET\ RISK}$, that are likely to be relevant to aviation debt securities are:

- Interest rate risk: SCR_{IR}
- Spread risk: SCR_{SPREAD}
- Market risk concentrations: SCR_{CONC}
- Currency risk: SCR_{FX}

Of the above four sub-modules,

- SCR_{CONC} is likely to be zero or very small due to the use of bankruptcy-remote SPVs in the issue of debt securities by aviation securitisation[1] vehicles;
- SCR_{FX} arises for Eurozone domiciled and EU regulated insurance undertakings from the U.S. Dollar ("USD") denomination of the bulk of aviation debt securities, however, this capital charge can be substantially eliminated with good foreign exchange hedging;
- $SCR_{INTEREST}$ is an implicit risk in all fixed income securities, however unlike most of the other sub-modules, the capital charges on this sub-module can be off set against the liabilities of the insurance undertaking. Where the aviation debt securities

[1] Securitisation means a transaction or scheme, whereby the credit risk associated with an exposure or pool of exposures is tranched, having both of the following characteristics: (a) payments in the transaction or scheme are dependent upon the performance of the exposure or pool of exposures; (b) the subordination of tranches determines the distribution of losses during the ongoing life of the transaction or scheme.

appropriately match the liabilities of the insurance undertaking, $SCR_{INTEREST}$ may be relatively small;

- SCR_{SPREAD}, the spread risk component of the market risk capital requirement of Solvency II, heavily penalises aviation ABS arising from securitisations. At the time of writing, August-September 2018, while the spreads and yields on securities in the aircraft sector of the ABS market are higher than in many other sectors of the ABS market, the cost of financing the capital requirements for such securities other than in unit-linked funds is more than likely to absorb much of the excess return from aviation debt securities for insurance undertakings.

4.4 How does one analyse an aviation debt security?

In the paper, the analysis of an aviation debt security is split into two parts: (i) the analysis of the aviation industry focusing on airlines and aircraft lessors; and (ii) the analysis of the individual debt security.

4.5 Conclusion: Challenges for the Salesperson

There are two major challenges for the salesperson selling aviation debt securities to insurance undertakings. The first relates to the SCR that the aviation debt security will give rise to if held by the insurance undertaking. The second relates to the structure of the insurance undertaking's asset management operations.

4.5.1 SCR Challenge

When a private individual considers an investment in aviation debt securities, he or she is mainly concerned with the return on the debt securities and the risk in terms of interest rate risk and credit risk of the debt securities. By contrast, when an insurance undertaking considers an investment in aviation debt securities it must evaluate not just the return and risk characteristics of the securities but also the impact of holding the securities on the insurance undertaking's SCR and on its financial statements. Appendix 7 illustrates the issue.

The calculation of an insurance undertaking's SCR can be performed using either a standard formula or by using a bespoke internally developed capital model which has been approved by the insurance undertaking's regulator.

In the case of an insurance undertaking using the standard formula to calculate its SCR, the Solvency II Delegated Acts published in October 2014 provide a good starting point as to the likely SCR to which the debt security will give rise. However, it will be difficult for the salesperson to assess the likely reduction in SCR arising from diversification benefits and any loss absorbing effects under the standard formula.

Internal models are more likely to be used by large insurance groups due to economies of scale in the development of the models and due to the nature and spread of the risks borne by these insurance undertakings. Smaller insurance undertakings may also use an internal model where it would be inappropriate to use the standard formula to assess their SCR as the standard formula would not accurately reflect the risks underlying the business.

The detail underlying the formulas and calibration of an insurance undertaking's internal model is proprietary knowledge and therefore the level of capital that would be required for specific investments would not generally be publicly available unless an insurance undertaking discloses such information. This presents both challenges and opportunities for those seeking to sell investments to insurance undertakings. The seller will not know whether the investment is likely to be capital intensive for the insurance undertaking. This represents a challenge to the seller. However, it is possible that an investment that may have a high SCR for an insurance undertaking subject to the standard formula may have a lower capital charge for some insurance undertakings with internal models. This represents an opportunity for the seller of aviation debt securities. The challenge is to find the insurance undertakings with internal models which assign a low capital charge to such debt securities.

4.5.2 Investment Operations Challenge

Insurance undertakings vary in their approach to investment management; some insurance undertakings manage their investments using an in-house investment management team while others outsource the investment management to external investment management firms; some insurance undertakings may employ both approaches. For the salesperson, the first step is to ascertain the approach being used and then to try and persuade both the solvency and capital management team on the one hand and the investment management team on the other hand of the merits of the aviation debt security.

5 Attractiveness to Insurance Undertakings

At the time of writing[2] the spreads and yields on securities in the aircraft sector of the ABS market are higher than in most other sectors of the ABS market.

As a rough guide to attractiveness, earlier in 2018[3], senior, secured, credit card ABS with a weighted average life ("WAL") of three years yielded 2.8% whereas aviation ABS of similar WAL and seniority yielded 4.3%.

Aviation ABS debt instruments are issued to finance the acquisition and operation of aircraft usually by an SPV[4] or trust. The SPV or trust does not generally engage in any other business nor does it issue any other debt. In the event of the failure of the operator of the aircraft, the structure of the SPV is usually such that it will not generally be consolidated with the failed operator in the winding up of the latter entity. Senior secured aviation debt securities issued by SPVs are a form of secured borrowings by SPVs.

The operation of the aircraft provides the income used to pay the holders of the debt securities. Further, there is a strong secondary market for aircraft which reduces the risk of aviation ABS debt securities.

One might reasonably ask: Why do aviation ABS securities offer such a premium over other ABS securities? The answer lies partly in the very specialised nature of the assets, aircraft and aircraft engines, underlying aviation ABS, partly in the nature of the industry, and partly in the risks involved in managing the leasing of the assets in the SPV which issues the debt securities.

The nature of aviation collateral is so specialised that only a relatively small number of investors are likely to possess the detailed aviation industry knowledge that is required to assess the collateral and the dynamics of the industry.

5.1 Risk and Return Characteristics of Aviation Debt Securities

In terms of risk and reward, the aviation debt securities market offers a full spectrum of credit risk from AAA rated debt through, secured debt, subordinated secured debt, and unsecured debt to mezzanine finance.

The lowest risk end of the spectrum offers debt securities guaranteed by the ECAs of highly-rated sovereigns such as Germany, France, the U.K. and the U.S.

Moving further up the risk scale, there are debt securities which represent secured lending to an SPV which owns one or more aircraft, leased them to one or more airlines, and under which the lender has taken security over the aircraft and the aircraft lease receivables. The servicing of the SPV is outsourced to an aircraft lessor or other entity with significant aviation collateral management experience. A EETC and the Class A bonds of an aviation asset backed security are examples of such debt securities.

[2] August-September 2018

[3] Citi Research. Global Asset-Backed Securities Focus dated 3 April 2018.

[4] See Appendix 6 for a more detailed discussion of special purpose vehicles.

Nearing the top of the risk scale, there are debt securities which represent unsecured lending to airlines and aircraft lessors and Class C bonds of an aviation ABS which in general are a form of mezzanine finance.

The bulk of aviation debt securities by value is denominated in USD. Thus, for EU insurance undertakings with Euro ("EUR") denominated liabilities, using USD denominated aviation debt securities to back non-linked liabilities of life insurance undertakings or the liabilities of non-life insurance undertakings leads to currency risk. Unless an insurance undertaking's investment management firm has proven currency forecasting skills, the currency exposure is unlikely to provide any long-term return; it will however contribute significantly to the risk of the portfolio. Hedging the USD exposure is likely to be the appropriate risk management strategy and will lead to a lower SCR for the insurance undertaking.

In view of the regulatory capital requirements constraining the investment portfolios of insurance undertakings, we shall confine our examination of aviation debt securities to the principle features of the lower risk, lower reward spectrum of the aviation debt security spectrum.

6 Aviation Debt Securities

6.1 Principal Types of Aviation Debt Securities

The principal types of aviation debt securities in order of increasing risk are as follows:

- Debt securities guaranteed by the ECAs of highly-rated sovereigns such as Germany, France, the U.K., and the U.S. See Appendix 2 for a more detailed note on ECAs.

- Class A[5] debt securities which represent secured lending to an SPV which owns one or more aircraft, has taken security over the aircraft and the aircraft lease receivables, and has outsourced the servicing of the SPV to an aircraft lessor or other entity with significant aviation collateral management experience.

  Examples of such debt securities that we shall examine later in the paper are as follows:
  - Class A EETC and
  - Class A bonds of an aviation ABS.

- Class B Aviation ABS debt securities ranking below Class A debt securities in terms of receipt of interest and repayment of principal.

- Debt securities which represent unsecured lending to airlines and aircraft lessors.

- Class C bonds of an aviation ABS which are a form of mezzanine finance.

In some cases, Class C bonds may be more secure than unsecured loans to airlines or aircraft lessors.

A brief overview of each of these main types of debt securities is provided below; more details of these types of debt securities may be found in Appendix 2.

6.1.1 Debt Securities Guaranteed by the Export Credit Agencies of Highly-Rated Sovereigns

ECAs are government agencies that provide financial support for the export of goods manufactured in the ECA's home state. In relation to aviation, the ECAs provide support for the export of aircraft manufactured within the ECA's economy to a buyer in another country.

[5] The credit risk associated with the pool of assets is tranched into different classes of debt. Payments to debt security holders from the transaction depend on the performance of the pool of assets. The subordination of tranches determines the distribution of losses during the on-going life of the transaction. Class A debt securities rank above Class B and Class C debt securities for interest and the repayment of capital.

In the case of aircraft, the ECA support generally takes the form of guarantees for loans made by lenders to overseas purchasers of aircraft which are manufactured in the home state of the ECA.
The ECA's client is the aircraft manufacturer. The aircraft manufacturer informs its potential customers that ECA support is available subject to certain conditions to support the purchase of the manufacturer's aircraft.

A typical ECA financing structure for the purchase of an aircraft will involve a loan of circa 85 per cent of the net price of the aircraft being advanced by a syndicate of banks to a bankruptcy-remote SPV as owner and lessor of the aircraft. The remaining 15 per cent of the net price of the aircraft may be paid for by an entity of substance or borrowed from commercial lenders. In the latter case, the loan will be subordinate to the syndicated, ECA backed loan. The SPV owner and lessor will then lease the aircraft to an airline.

The term of such debt securities is typically of the order of 12 years and the debt may be listed on a regulated market.

Where different parts of an aircraft are made in more than one country, several ECAs may be involved in guaranteeing a syndicated loan. In the case of an Airbus aircraft, Bpifrance would provide support to lenders for a syndicated loan in respect of the French portion of the aircraft, Euler Hermes to the German portion, and the U.K. Export Finance in respect of the U.K. portion. The wings for Airbus aircraft are mostly assembled in the U.K. and sometimes Rolls Royce makes the engines, so the U.K. content of an aircraft may vary from 20 per cent to 40 per cent depending on whether Rolls Royce engines are installed on the aircraft.

ECA finance is currently an expensive form of finance. For many airlines, it is currently a 'last resort' form of finance as it typically requires cross default and cross collateralisation with respect to other ECA financings. Further, there is limited scope for an airline or aircraft lessor to negotiate terms with an ECA.

6.1.2 Enhanced Equipment Trust Certificate

A EETC is a debt security issued by a trust to investors who subscribe debt capital to finance the purchase of an aircraft by the trust for onward lease to an airline. Lease payments by the airline are used to service the payments under the trust's debt securities.

The value of an aircraft depreciates over time, so to ensure that the residual value of the aircraft is greater than the debt outstanding under the debt securities, the term to maturity of a EETC is usually significantly shorter than the expected life of the aircraft. The expected life of a commercial aircraft is of the order of 25 years whereas the term of EETCs is of the order of 10 to 12 years.

Legal title to the aircraft remains with the trustee of the trust for the benefit of the bondholders until the debt has been repaid at which point title to the aircraft passes to the airline. As legal title to the aircraft does not pass to the airline until the debt is repaid, the aircraft is not considered to be the property of the airline if the airline becomes bankrupt. Typically, a bank will act as the trustee of an EETC.

The lease is more in the nature of a finance lease than an operating lease as the airline receives title to the aircraft at the end of the lease. In the United States, EETCs enjoy certain tax benefits compared with mortgages.
The creditworthiness of a EETC is enhanced from the perspective of the debt security holders by three major features:

1. The debt security of a EETC is divided into at least two classes of debt security. Each class has different payment priorities and different claims over the collateral in the event of a winding up of the trust. The loan-to-value ("LTV") statistic for the highest rated class of debt securities would be significantly less than one (1.0) thereby pushing the risk of default down to the lower classes of debt security and ultimately to the most subordinated investors in the structure. An investment grade rating may be obtained for the class of debt securities with the highest payment and asset claim priorities. EETCs usually provide that a default by the airline on any payment obligation under the EETC will trigger a default with respect to all aircraft that secure the EETC. Thus, subject to subordination agreements between the different classes of investors, all proceeds of aircraft equipment collateral are available to all investors if there is a default by the airline on any obligation;

2. EETC certificates are issued to purchasers of debt securities by a trust which owns the aircraft. This structure reduces the exposure of the owner of the aircraft to the insolvency of the airline; and

3. Debt security holders want certainty as to the time it may take to repossess and either realise the value of or remarket their collateral for lease to another airline. EETCs offer a liquidity facility to provide for the continued payment of interest on the EETCs following the default of the lessee during the period when the aircraft underlying the EETC is being repossessed and sold to repay principal or remarketed to other airlines. Section 1110 of the U.S. Bankruptcy Code provides predictable access to aircraft equipment within 60 days in the event of a U.S. airline bankruptcy.

EETC debt securities tend to have better credit ratings than the corporate credit rating of the lessee and hence permit the financing of aircraft by airlines at a lower cost than if the airline financed the aircraft using corporate debt.

6.1.3 Class A Aviation ABS Debt Securities

Class A ABS aviation debt securities represent secured lending to an SPV which owns one or more aircraft, has taken security over the aircraft and the lease receivables for that aircraft, and outsourced the servicing of the SPV to an aircraft lessor or other entity with significant aviation collateral management experience.

Appendix 2 outlines a sample payments waterfall. In the sample payments waterfall, interest on Class A debt securities are the 2nd item to be paid out of cash flows accruing to the securitisation SPV and scheduled repayments of principal to the holders of Class A debt securities are ranked 7th in the payments waterfall.

An aviation ABS debt security issue provides a means for an aircraft lessor to move aircraft off its balance sheet by transferring the aircraft to an SPV which issues bonds to finance the purchase of the aircraft. Aviation ABS debt securities may be used by aircraft lessors to dispose of mid-life and end-of-life aircraft.
Only a very small number of Class A ABS aviation debt securities arising from securitisations by aircraft lessors have a credit rating in excess of A (S&P).

Aviation ABS debt securities are complex to analyse and usually involve the analysis of factors such as:

1. Purpose of the securitisation;
2. Structure of the SPV including the payments 'waterfall';
3. Assessment of the entity managing and operating the collateral pool;
4. Inherent business risks in the collateral and operation of the SPV;
5. Cash flow modelling; and
6. Conflicts of interest between parties such as the SPV and lessor-service-provider.

6.1.4 Class B Aviation ABS Debt Securities

Class B Aviation ABS debt securities rank below Class A debt securities in terms of receipt of interest and repayment of principal in a typical aviation securitisation structure.

Class B aviation ABS debt securities carry a higher risk and return potential compared with Class A. They normally carry a higher coupon rate, have a higher LTV ratio, and less credit enhancement than the corresponding Class A securities.

Appendix 2 outlines a sample payments waterfall. In the sample payments waterfall, interest on Class B debt securities are the 3rd item to be paid out of cash flows accruing to the securitisation SPV and scheduled repayments of principal to the holders of Class B debt securities are ranked 8th in the payments waterfall.

6.1.5 Unsecured Debt – Credit Risk Assessment

Unsecured debt is not backed by a pool of collateral and holders of unsecured debt generally rank with the general body of creditors in a winding up of an entity.

Regardless of whether the aviation entity is an airline or an aircraft lessor, a thorough due diligence would analyse:

- the operating and marketing strategy,
- the quality of management and its track record in executing its stated strategy,
- the identity of the owners, and the ownership structure of the entity,
- the position of the debt security in the debt structure of the issuer,
- the issuer's covenants,
- currency exchange rates affecting the issuer,
- bankruptcy laws in the jurisdiction of the issuer,
- the quality of the promise to pay,
- where relevant, would a new government privatise a state owned carrier or abandon it altogether, and

- the environmental, social, and governance ("ESG") policies of the issuer.

Meetings with suppliers, customers, former employees, and competitors of the entity subject to due diligence usually provide unique insights into the strengths and weakness of the entity.

Unsecured Lending to Airlines

Some airlines issue debt securities to finance their operations and such debt securities are essentially corporate bonds. In addition to the general due diligence points above, an analysis of unsecured debt of passenger airlines would, at a minimum, need to consider: the risks faced by the industry[6], the stage in the air travel growth cycle, country risk in the jurisdiction of the airline, and the position, balance sheet strength, profitability, and cash flows of the issuing airline in the industry. Access to capital to weather downturns, take advantage of opportunities, and to fund expansion is also important.

The debt securities of airlines with any one or more of the following characteristics are probably best avoided: (i) unclear or frequently changing strategies; (ii) target niche routes or customer segments which have proved in the past to be unsuccessful; (iii) failing to adapt to changing market and economic conditions; (iv) poor load factors; (v) highly leveraged balance sheet; (vi) poor margins even particularly when oil prices are low; (vii) continuing reliance on exceptional items to generate profit; (viii) significant foreign exchange risk which is poorly managed; (ix) lack of access to additional capital.

Unsecured Lending to Aviation Lessors

In addition to the general due diligence points above, the due diligence on unsecured debt securities of aviation lessors would, at a minimum, need to also examine:

- The economics of the aviation industry;
- The stage in the air travel growth cycle;
- The experience, track record, and effectiveness of the management team;
- The value, diversification, age, and marketability of its portfolio of aircraft including the geographic diversification, term to expiry profile of leases, and strength of the covenants of its lessees; the country risks it faces in terms of the jurisdiction of operation of its airline lessees;
- The level of debt amortisation relative to depreciation for individual aircraft in the portfolio;
- The balance sheet strength; the degree of balance sheet leverage; sensitivity to rising interest rates; composition of profits as between rental income, profit on the sale of aircraft, and third-party fee income; and position of the aviation lessor in the industry;
- The emerging trend in the free cash flow from the lessor's operations; and
- The size of the aircraft lessor's order book for new aircraft as a percentage of total fleet and the funding requirements of the associated pre-delivery payments. Aircraft lessors face a trade-off in terms of the size of their order books. On the one hand, orders for new aircraft provide potential new product streams for the lessor to market to airlines and need to be sufficiently large to obtain significant discounts. On the other hand, large orders increase the risk of the lessor in terms of funding the pre-

[6] Outlined later in the paper.

delivery payments on the orders and in terms of finding lessees for the new aircraft when they are delivered.

A model of the cash flows of the aircraft lessor would also be created to examine the sensitivity of the cash flows to various types of stress events.
The credit rating of the senior unsecured debt of the largest aircraft leasing companies in the world is typically just above or just below investment grade debt. For example, as of September 2018, some senior unsecured debt of Aercap Holdings N.V. was rated BBB- by S&P. BBB- is the lowest investment grade credit rating within the S&P investment grade category.

6.1.6 Class C Aviation ABS Debt Securities

While Class C aviation ABS debt securities are sometimes seen as riskier than unsecured bonds issued by airlines and aircraft lessors, in some cases, Class C bonds may be more secure than unsecured loans to airlines or aircraft lessors. Each case must be evaluated individually.

Class C aviation ABS debt securities rank below Class A and Class B debt securities in terms of receipt of interest and repayment of principal in a typical aviation securitisation structure.

Class C debt securities perhaps carry the highest risk and return potential among aviation debt securities. They normally carry a higher coupon rate, have a higher LTV ratio, and less credit enhancement than the Class A or Class B securities. The expected maturity of Class C debt securities tends to be shorter than that of Class A and Class B debt securities.

For example, in the Castlelake[7], CLAS 2016-1 aviation ABS debt security which came to the market in August 2016 with three tranches, Class A (senior secured), Class B (subordinated secured), and Class C (mezzanine finance), had respectively coupons of 4.45%, 6.15%, and 8.00%, LTVs of 64%, 76%, and 82%, and credit enhancement percentages of 36%, 24%, and 18%.

Appendix 2 outlines a sample payments waterfall. In the sample payments waterfall, interest on Class C debt securities are the 16th item to be paid out of cash flows accruing to the securitisation SPV and scheduled repayments of principal to the holders of Class C debt securities are ranked 18th in the payments waterfall.

[7] Source: Business Wire. Castlelake L.P. is a global private investment firm. On Monday 1 August 2016, it priced its third aircraft securitization: Castlelake Aircraft Securitization Trust 2016-1 (CLAS 2016-1). https://www.businesswire.com/news/home/20160802005712/en/Castlelake-Prices-Castlelake-Aircraft-Securitization-Trust-2016-1

7 Issues for Insurance Undertakings

Insurance undertakings purchasing any kind of debt security would consider the suitability of the debt security under at least the following seven headings:

1. Debt security's suitability for matching liability cash flows;
2. The *prudent person principle* defined in the Solvency II legislation;
3. Risk and return characteristics of the debt security;
4. Impact of the debt security on the insurance undertaking's market risk SCR;
5. Risk appetite of the insurance undertaking as set down in its Own Risk and Solvency Assessment ("ORSA");
6. Liquidity of the debt security; and
7. Financial reporting issues relating to the debt security.

7.1 Debt security's suitability for matching liability cash flows

Insurance undertakings are liability driven businesses with assets purchased to back the expected liability outgo under their portfolios of policies and the undertaking's own funds. The selection and management of these assets is critical. In this section we summarise the nature of the major types of liabilities of life and non-life[8] insurance undertakings.

Unit-linked Liabilities

Unit-linked liabilities are liabilities to policyholders in respect of investments in pools of assets. The life insurance undertaking is the legal and the beneficial owner of the different pools of assets; policyholders hold units in these pools of assets which mostly determines the extent to which the value of their policies rise or fall in value. The net asset value of the pools of assets are determined usually daily and divided by the number of units in existence to determine a unit price. Broadly speaking, if the life insurance undertaking holds the assets necessary to match the liabilities for the units in issue, then assuming there are no mismatches in the income and expense outgo under the policies, there is no market risk SCR.

While a unit-linked fund investing in ECA-guaranteed aircraft finance debt securities, EETCs, and aviation ABS debt securities may contribute little to the Solvency II market risk SCR of the insurance undertaking, these debt securities tend to be highly illiquid.

If a unit-linked fund were a forced seller of any of these types of securities, especially EETCs and aviation ABS debt securities, to meet redemptions there is likely to be a significant reduction in the price at which the securities can be converted to cash compared with the most recent estimated valuations. EETCs and aviation ABS debt securities tend to be held by closed-end investment funds in which investors are not allowed to redeem or sell shares or units for a certain period of time generally of the order of several years often referred to as a long lock-up period. A life insurance undertaking offering a unit-linked fund investing in aviation ABS debt securities could provide in its policy conditions for a right to defer encashments for a number of months. However, this would to some extent defeat the daily liquidity feature of the fund. Thus, their suitability for inclusion to any significant extent in a unit-linked fund that is priced daily is likely to be limited.

[8] Also referred to as general insurance or property and casualty insurance.

Non-linked Liabilities of Life Insurance Undertakings

Non-linked liabilities are usually in respect of guarantees provided to policyholders; for example, the payment of a monthly income to a person who purchased an annuity for life or the payment of a lump sum on the death or serious illness of an insured life. In view of the guaranteed nature of this business, the SCR for this type of business is significantly greater than for unit-linked business.

Term

The term of non-linked liabilities such as annuities tends to be very long. While the legal maturity of aviation ABS debt securities may be of the order of 20 years for a collateral pool of mid-life aircraft, its expected maturity is more likely to be of the order of 7 years. Thus, aviation debt securities are unlikely to be a good match for the long-term liabilities of insurance undertakings.

Currency Risk

The bulk of aviation debt securities are denominated in USD. For a Eurozone domiciled and EU regulated insurance undertaking, it is difficult to transform the USD denominated cash flows from an aviation debt security into fixed cash flows in EUR for the purposes of asset liability matching. The choice of hedging strategy[9] seems to be between:

(i) A currency swap providing the transformation but at the expense of ongoing volatility in the valuation of the currency swap; and

(ii) A portfolio of EUR/USD forward foreign exchange contracts and interest rate swaps in both USD and EUR providing lower mark-to-market volatility but without delivering perfect, fixed EUR denominated cash flows.

Thus, aside from liquidity issues which at the very least constrain a life insurance undertaking's ability to rebalance its portfolio, many aviation ABS debt securities give rise to currency hedging issues which require specialist currency risk management skills.

In terms of risk appetite and understanding well the risks an insurance undertaking is taking, only those insurance undertakings with expertise in the aviation debt securities market are likely to invest in aviation debt securities for backing non-linked liabilities.

Non-life Short-term Liabilities

While ECA guaranteed aircraft finance debt securities offer government credit risk, they tend to be somewhat illiquid. Thus, despite the attraction of the small yield spread over government debt securities, the lack of liquidity and the currency risk management issues arising, are likely to render them unsuitable as a match for the short-term liabilities that arise in commercial and personal lines of non-life insurance business. EETCs and ABS aviation debt securities while also presenting the challenges mentioned in the previous sentence, also give rise to very high regulatory capital charges as measured by the undiversified market risk SCR, which taken together is likely to rule them out of consideration as suitable assets to back short-term, non-life liabilities.

[9] See Appendix 5 for a more detailed discussion of currency hedging.

Own Funds

To secure an authorisation as an insurance undertaking, an entity is required to hold a certain amount of capital.

The level of capital required is calculated using a prescribed calculation which assesses the potential 1 in 200-year risk to the entity over the next 12 months. This includes risks to the balance sheet and risks arising from anticipated volumes of business in the business plan. Under the Solvency II regulations, the excess of assets over liabilities is referred to as *own funds*.

Despite their somewhat illiquid nature, aviation debt securities that do not give rise to a substantial market risk SCR, may be suitable assets for part of the *own funds* of an insurance undertaking.

7.2 Prudent Person Principle

Insurance undertakings in the EU are required by Article 132 of the Solvency II Directive to comply with the *prudent person principle* in relation to their investment policy. Broadly speaking, the *prudent person principle* requires:

- **Requirement:** With respect to the whole portfolio of assets, insurance undertakings shall only invest in assets and instruments whose risks the undertaking concerned can properly identify, measure, monitor, manage, control and report, and appropriately take into account in the assessment of its overall solvency.
  Comment: In relation to investing in aviation debt securities, consideration would need to be given to the skills necessary to properly understand the risks and model the cash flows underlying such securities.

- **Requirement:** All assets, in particular those covering the Solvency Capital Requirement, must be invested in such a manner as to ensure the security, quality, liquidity and profitability of the portfolio as a whole.
  Comment: Considering this point, the relative lack of liquidity of aviation debt securities needs to be considered in the context of the liabilities.

- **Requirement:** Assets held to cover the technical provisions shall also be invested in a manner appropriate to the nature and duration of the insurance and reinsurance liabilities. Those assets must be invested in the best interest of all policy holders and beneficiaries taking into account any disclosed policy objective.
  Comment: The term to maturity or in some cases the expected term of aviation debt securities needs to be carefully matched with the term of the liabilities.

- **Requirement:** The use of derivative instruments shall be possible insofar as they contribute to a reduction of risks or facilitate efficient portfolio management.
  Comment: The bulk of aviation debt securities by value are denominated in USD and for a Eurozone domiciled and EU regulated insurance undertaking the USD exposure would need to be hedged when used to back non-linked life and non-life liabilities. Such hedging will involve the use of derivatives like currency swaps or forward foreign

exchange contracts and while such derivatives substantially remove the foreign exchange risk they introduce several other risks which need to be managed including valuation & market risk, counterparty risk, legal risk, operational risk, and market risk.

- **Requirement:** Investments and assets which are not admitted to trading on a regulated financial market shall be kept to prudent levels.
  Comment: This requirement may be adhered to by investing in aviation debt securities quoted on a regulated market.

- **Requirement:** Assets shall be properly diversified in such a way as to avoid excessive reliance on any particular asset, issuer or group of undertakings, or geographical area and excessive accumulation of risk in the portfolio as a whole.
  Comment: While individual aviation debt securities tend to be issued by an SPV which is bankruptcy remote from other such securities, airline operators, and aircraft lessors, as we shall see later in the paper, all aviation debt securities are subject to several common risk factors. Thus, the overall portfolio level exposure to the aviation industry ought to be considered carefully.

- **Requirement:** Investments in assets issued by the same issuer, or by issuers belonging to the same group, shall not expose the insurance undertakings to excessive risk.
  Comment: Helpfully in this regard, individual aviation debt securities tend to be issued by an SPV which is bankruptcy remote from other such securities, airline operators of aircraft, and aircraft lessors.

7.3 Risk Appetite of the Insurance Undertaking

The amount and nature of the risks that an insurance undertaking will accept (i.e. its risk appetite), in pursuit of its strategic objectives is likely to be determined by several factors including:

- Understanding well the risks it is taking and being able to manage them well;
- The nature of its liabilities especially where those liabilities are non-linked liabilities; and
- Ensuring the resilience of its balance sheet in terms of being able to meet liabilities to policyholders and its solvency capital requirement in extreme but plausible stress scenarios.

7.4 Impact of Aviation Debt Securities on an Insurance Undertaking's Market Risk SCR

Insurance undertakings are required to hold capital against the risk of a decline in balance sheet asset values. In the EU, Solvency II is a legal framework for the regulatory authorisation and supervision of insurance undertakings with head offices in one member state of the EU to conduct insurance and reinsurance undertakings throughout the EU. Solvency II provides for coordinated rules relating to the supervision of insurance groups and to the reorganisation and winding-up proceedings in respect of insurance undertakings. It also provides rules for the valuation of assets, technical provisions, and other liabilities.

Appendix 1 to the paper provides a general overview of the Solvency II market risk SCR applicable to aviation debt securities.

When a private individual considers an investment in aviation debt securities, he or she is mainly concerned with the return on the debt securities and the risk in terms of interest rate risk and credit risk of the debt securities. By contrast, when an insurance undertaking considers an investment in aviation debt securities it must evaluate not just the return and risk characteristics of the securities but also the impact of holding the securities on the insurance undertaking's solvency capital requirements and on its financial statements.

The paper limits its scope by assuming that insurance undertakings calculate their solvency capital requirements using the Solvency II "Standard Formula". All estimates of the components of the market-risk SCR in the standard formula are: (i) based on the authors' interpretation of the Solvency II Delegated Acts published in October 2014; (ii) before diversification benefits; and (iii) gross of any loss absorbing effects.

In the Solvency II standard formula, the sub-modules of the market risk SCR, $SCR_{MARKET\ RISK}$, relevant to aviation debt securities are:

- interest rate risk: SCR_{IR}
- spread risk: SCR_{SPREAD}
- market risk concentrations: SCR_{CONC}
- currency risk: SCR_{FX}

Under the standard formula, government bonds, ECA guaranteed aircraft finance debt securities offering government credit risk, and certain debt securities issued by the ECB, supranational organisations, and multilateral development banks give rise to interest rate risk SCR and may give rise to currency risk SCR, but they do not give rise to spread or concentration risk SCR.

Here we focus mainly on the spread risk SCR, SCR_{SPREAD}, as this is likely to be the largest contributor to the market risk SCR for EETC and securitised aviation debt securities. We briefly comment on why the remaining three components above of the market risk SCR tend to be relatively less significant for EETC and securitised aviation debt securities.

Spread risk is the sensitivity of the values of assets and liabilities to changes in the level or in the volatility of credit spreads over the risk-free interest rate term structure. Spread risk assumes that spreads will increase on all instruments in a 1 in 200-year event. As SCR_{SPREAD} is a capital requirement for sensitivity to credit spread movements it is a function of: (i) the credit quality; and (ii) the duration of each position. Regardless of the actual duration of a debt security, the minimum value of duration used in the calculation of SCR_{SPREAD} is one (1) year under the Standard Formula.

Spread risk is calculated using the following formula:

$$SCR_{SPREAD} = SCR_{BONDS\ AND\ LOANS} + SCR_{SECURITISATION} + SCR_{CREDIT\ DERIVATIVES}$$

The spread risk formula makes no allowance for diversification between its three components.

EETCs and aviation ABS debt securities are securitisations[10] and are likely to be classified as Type 2 securitisations for the reasons set out in Appendix 3. Therefore, the $SCR_{BONDS\ AND\ LOANS}$ and $SCR_{CREDIT\ DERIVATIVES}$ are not applicable to EETCs and ABS securitisations of aviation assets.

To illustrate the SCR_{SPREAD} capital requirement arising from holding an aviation ABS debt security we now examine the securitisation from Castlelake which we mentioned earlier and which has ticker "CLAS 2016-1". The only term in the SCR_{SPREAD} that applies is the $SCR_{SECURITISATION}$ term[11].

CLAS 2016-1 is an aviation ABS debt security which came to the market near the end of July 2016 with three tranches, Class A (senior secured), Class B (subordinated secured), and Class C (mezzanine finance), having coupons of 4.45%, 6.15%, and 8.00% respectively.

The rising level of coupon from Class A through Class B to Class C, reflects an increasing level of risk and this is borne out by the initial credit ratings for the three classes which were A, BBB, and BB respectively.

Table 1 below summarises some of the key points of the CLAS 2016-1 securitisation when it was issued in July 2016.

Table 1
CLAS 2016-1 Securitisation

Class	Nominal Value (USD millions)	Loan-to-value (per cent)	Credit Enhancement (per cent)	Coupon (per cent)	Rating (KBRA[12])
A	715	64	36	4.45	A (sf)
B	130	76	24	6.15	BBB (sf)
C	71	82	18	8.00	BB (sf)

Sources: Citi Research Securitized Products 3 April 2018 and KBRA.

[10] Recital 2 of the EU Regulatory Technical Standards which apply to the disclosure of information relating to structured finance instruments states: "*An exposure that creates a direct payment obligation for a transaction or scheme used to finance or operate physical assets should not be considered an exposure to a securitisation, even if the transaction or scheme has payment obligations of different seniority*". Interestingly, recital 2 is a repeat of recital 50 of the Capital Requirements Regulation ("CRR"). The authors understand that the Securitisation Regulation amends banks' prudential treatment (i.e. the CRR) but not that of insurance undertakings (i.e. Solvency II). Apparently, the necessary changes to the Solvency II Delegated Regulation can only be adopted after the Securitisation Regulation has been adopted. If that is the case the standard formula capital charge would be the same as bonds of the equivalent rating/duration. For example, an unrated 10-year bond would attract a capital charge of 23.5% or 11.75% if the collateral was deemed to meet the requirements of Article 214, which we expect to be very difficult to apply for aircraft.

[11] Appendix 3 discusses the $SCR_{SECURITISATION}$ issue in detail. Only the conclusions of the discussion are presented at this point in the paper.

[12] KBRA appends an (sf) indicator to ratings assigned to structured finance obligations.

Table 2 shows the $SCR_{SECURITISATION}$ and the cost of financing the $SCR_{SECURITISATION}$ for each of the Class A (senior secured), Class B (subordinated secured), and Class C (mezzanine finance) debt securities of the CLAS 2016-1 aviation ABS.

Table 2

Class	Rating (KBRA)	Credit quality step	b_i (per unit of duration)	Modified Duration (as at 3 September 2018[13])	SCR before diversification	Cost of financing SCR at 6% per annum
					Percentage of Value of Security	
A	A (sf)	2	16.6%	2.17	36.02%	2.16%
B	BBB (sf)	3	19.7%	2.16	42.55%	2.55%
C	BB (sf)	4	82.0%	1.02	83.64%	5.02%

The undiversified market risk $SCR_{SECURITISATION}$ that these ABS debt securities generate as a percentage of the value of the securities is very large compared with other debt securities of similar credit ratings. Further, the very high cost of financing the $SCR_{SECURITISATION}$ capital is likely to wipe out any yield premium these securities offer and to rule them out of consideration as an investment for an insurance undertaking. The Class C security is likely to be also ruled out by most insurance undertakings other than those with specialist knowledge of aviation ABS debt securities because its credit rating is below investment grade.

Currency Risk Sub-Module - SCR_{FX}

Securities denominated in USD give rise to currency risk for Eurozone domiciled and EU regulated insurance undertakings and thereby create a capital charge, SCR_{FX}, under Solvency II. The SCR_{FX} is potentially very significant for Eurozone domiciled and EU regulated insurance undertakings. The size of the SCR_{FX} is potentially very significant because it is calculated on the basis of an instantaneous 25% increase or decrease, whichever generates the greater loss, in the value of all foreign currencies against the EUR.

However, the SCR_{FX} can be mitigated by currency hedging techniques such as the use of forward foreign exchange contracts of appropriate notional value. The increase and decrease in the value of all foreign currencies against, in this case, the EUR, in the SCR_{FX} formula is specifically designed to capture the mitigation effect of hedging foreign exchange risk. Thus, with a carefully designed and well executed hedging strategy, the SCR_{FX} is unlikely to be a significant contributor to the $SCR_{MARKET\ RISK}$ for aviation debt securities.

It is important to note that the exposure to the default of the counterparty to the foreign exchange hedging contracts is not treated in the SCR_{FX} sub-module of $SCR_{MARKET\ RISK}$. It is covered by another module, the counterparty default risk module. However, provided the foreign exchange hedging contracts provide for bilateral posting of collateral of appropriate quality, the counterparty risk contribution to the overall undiversified SCR ought to be small compared with the SCR_{SPREAD}.

[13] Source: Bloomberg.

Market Risk Concentrations Sub-Module - SCR_{CONC}

Concentration refers to exposures to entities which belong to the same corporate group rather than exposure to a single geographic or industrial segment. The SCR_{CONC} treats exposures to entities which belong to the same corporate group as exposures to a single entity.

SCR_{CONC} applies if the aggregate exposure to a single corporate group exceeds a given threshold. No Solvency II capital charge arises where the aggregate exposures to a single corporate group is less than or equal to the threshold. The threshold depends on the credit rating of the exposure.

Threshold

The threshold is 3.0% of the asset base for single-name exposure to names of credit quality steps 0, 1 & 2, AAA, AA, and A respectively for S&P rated debt.

Even if the credit exposure to EU Member States, the ECB, supranational organisations and multilateral development banks exceeds 3.0% of the asset base, such exposures do not contribute to the SCR_{CONC} as the concentration risk factor for such exposures is zero. Such exposures do however contribute to the asset base despite having a zero-concentration risk factor.

The threshold is 1.5% of the asset base for single-name exposure to names of credit quality below step 2, S&P debt rated BBB+ and lower.

Asset Base

The asset base is the total amount of assets considered in the SCR_{CONC} sub-module. Credit exposures to EU Member States, the ECB, supranational organisations and multilateral development banks contribute to the asset base despite having a zero-concentration risk factor. The asset base includes assets considered in the equity risk, spread risk, and property risk sub-modules but excludes assets considered in the counterparty default risk module.

For an insurer with a SCR_{CONC} asset base of say EUR10 billion, the 1.5% threshold would require exposure to a single corporate group to exceed EUR150m for the debt security to contribute to SCR_{CONC} under the Standard Formula.

SPV Structure of Aviation Debt

EETCs and aviation asset backed securitisations are generally issued through bankruptcy-remote SPVs which are usually constructed specifically to ensure that they are not consolidated with the airline in the case of EETCs and with the aircraft lessor in the case of asset backed securitisations should the airline or the aircraft lessor be wound up.

Even if an insurance undertaking owns both debt securities issued by an airline and holds debt securities issued by a EETC which owns and leases an aircraft to the airline, the authors' view is that the two sets of securities should not be aggregated together for the purpose of calculating the market risk concentrations sub-module, SCR_{CONC} because of the bankruptcy-remote structure of the EETCs and aviation ABS securitisations.

Market Risk Interest Rate Risk Sub-Module – $SCR_{INTEREST}$

Interest rate risk is the sensitivity of the values of assets and liabilities of an insurance undertaking balance sheet to changes in the term structure of interest rates.

$SCR_{INTEREST}$ captures the impact of a prescribed change in the term structure of interest rates on both the asset and the liabilities of an insurance undertaking.

$SCR_{INTEREST}$ is an implicit risk in all fixed income securities, however, unlike most other sub-modules of the market risk SCR, the capital charges arising from this sub-module can be reduced by offsetting changes in an insurance undertaking's liabilities.

Interest rate risk only assesses the sensitivity of balance sheet assets and liabilities to changes in the risk-free interest rate curve. Changes in spreads over the risk-free rate curve are not covered in the interest rate risk sub-module of the market risk SCR rather they are dealt with in the spread risk sub-module of the market risk SCR. Such changes in spreads are left unchanged in the calculation of $SCR_{INTEREST}$.

The solvency capital requirement for interest rate risk is calculated by applying an upward and a downward shock to the term structure of interest rates on a currency by currency basis. The stress applied to the yield curve is relative to the current level of interest rates and varies by term.

In the upward interest rate stress, the relative shock declines with maturity and ranges from +70% for one-year maturities, through +26% for 20-years to maturity, to +20% for the longest maturities, 90 years, subject to a minimum increase in interest rates of 1% for all maturities. The upward interest rate stress for terms between 20 and 90 years to maturity is calculated using linear interpolation.

In the downward interest rate stress, the relative shock declines with maturity and ranges from -75% for one-year maturities, through -29% for 20-years to maturity, to -20% for the longest maturities, 90 years. Again, the downward interest rate stress for terms between 20 and 90 years to maturity is calculated using linear interpolation. No shock is applied to negative rates of interest.

The revised term structures of interest rates are derived as follows for the upward and downward shocks and are set out in Equation A below:

Equation (A)

$$\max \{(1 + SHOCK(M)^{UP}) * I_M, I_M + 1\%\} \quad \text{(the upward shock formula)} \ (I)$$

and

$$(1 + SHOCK(M)_{DOWN}) * I_M \quad \text{(the downward shock formula)} \ (II)$$

where $SHOCK(M)^{UP}$ is the upward shock to interest rates for a term of M years, $SHOCK(M)_{DOWN}$, the downward shock to interest rates for a term of M years, and I_M the

current rate of interest for a term of M years. As we can see from equation (A) (I) above, there is a minimum upward interest rate shock of 1%.

The alternative term structures derived from these shocks give rise to changes in the value of the assets and of the liabilities.

Interest rate risk is calculated as the greater of the following, subject to a minimum of zero:

- The additional capital requirement relating to an increase in the term structure of interest rates; and
- The additional capital requirement relating to a decrease in the term structure of interest rates.

Where the aviation debt securities appropriately match the liabilities of the insurance undertaking, $SCR_{INTEREST}$ may be relatively small. See Appendix 4 in relation to this issue. However, recent indications from EIOPA have suggested that the upward and downward stress test for the risk-free curve should be changed, the effect of which is likely to increase $SCR_{INTEREST}$.

7.5 Liquidity

The liquidity of aviation debt securities tends to be somewhat less than that of government debt securities and mainstream corporate bonds and this is particularly so in distressed market conditions.

Solvency II values assets at market value. Securities which trade infrequently or for which there are no significant market makers pose valuation problems.

The lack of liquidity of aviation debt securities makes it difficult to include them to any great extent in unit-linked funds offering daily liquidity and in the portfolios of non-life insurance undertakings writing short-term business.

There are signs that liquidity is improving as more securities are issued under Rule 144A and Regulation S[14] of the Securities Act 1933. Rule 144A modified a requirement for a two-year holding period for privately placed securities. The rule permits qualified institutional buyers ("QIBs") to trade securities issued under the rule among themselves during the two-year holding period. Rule 144A substantially increases the liquidity of the securities issued under the rule for QIBs.

[14] Regulation S and Rule 144A derive from the U.S. Securities Act of 1933 and create safe harbours from SEC registration. Under Rule 144A, a U.S. or international entity may engage in a private placement offering of securities to US investors meeting the definition of qualifying institutional buyer ("QIB"). In essence, a QIB is a professional investor that ought to know what it is doing and not need SEC protection. Regulation S covers bond offerings sold outside the U.S. to international investors and which are not sold directly to and don't involve U.S. parties.

7.6 Financial reporting for aviation debt securities

Under this heading, we briefly discuss the treatment of the debt securities in the audited financial statements of the insurance undertaking which reports under International Financial Reporting Standards ("IFRS"). The main relevant IFRS standard is IFRS 9.

Effective Date

IFRS 9, Financial Instruments, became effective for annual periods beginning on or after 1 January 2018. IFRS 9 replaced IAS 39, Financial Instruments: Recognition and Measurement. Insurance undertakings have the option to delay the adoption of IFRS 9 until they adopt IFRS 17 for annual periods from 1 January 2021[15].

Overview

IFRS 9 sets out the requirements for the classification and measurement of financial instruments, the impairment of financial assets, and for hedge accounting.

Classification and Measurement

IFRS 9 classifies and measures financial assets at either:

(1) amortised cost;
(2) fair value through other comprehensive income; or
(3) fair value through profit and loss.

Initial measurement of financial instruments

Aviation ABS debt securities are initially measured at fair value. IFRS 9 divides all financial assets into two classifications namely, those measured at amortised cost and those measured at fair value. Given the characteristics of an aviation ABS debt security and that it is likely to be held for trading, it must be measured at fair value through other comprehensive income rather than at amortised cost.

Impairment

During the financial crisis, the delayed recognition of credit losses on loans was identified as a weakness in existing accounting standards. IFRS 9 requires more timely recognition of expected credit losses through the application of expected-loss impairment models.

The impairment model in IFRS 9 is based on the premise of providing for expected losses. Expected credit losses are required to be measured through a loss allowance at an amount equal to:

1. The 12-month expected credit losses defined as expected credit losses that result from those default events on the financial instrument that are possible within 12 months after the reporting date; or

[15] At its November 2018 meeting, the International Accounting Standards Board proposed to extend the mandatory effective date of IFRS 17 by one year to 1 January 2022 together with an extension of one year for the adoption of IFRS 9 for insurance undertakings who will be adopting IFRS 17.

2. Full lifetime expected credit losses defined as expected credit losses that result from all possible default events over the life of the financial instrument.

Disclosures

IFRS 9 amends some of the requirements of IFRS 7, *Financial Instruments: Disclosures,* including adding disclosures about risk management activities, hedge accounting, and disclosures on credit risk management and impairment.

Developing IFRS 9 reporting requirements in respect of aviation debt held by insurance undertakings is likely to be complex, time consuming and expensive.

8 Analysing Aviation Debt Securities

The analysis of an aviation debt security is split into two parts: (i) the analysis of the aviation industry focusing on airlines and aircraft lessors; and (ii) the analysis of the individual debt security.

8.1 Overview of Economic Drivers of the Aviation Industry

8.1.1 Passenger Airlines

Air passenger numbers[16] have grown at a rate of 5% per annum from 1980 to 2017 in part due to an expanding middle class especially in emerging markets in Asia. This growth in passenger numbers fuels demand for new routes and provides opportunities for new fledgling carriers in regions which were not well serviced by airline travel in the past.

The passenger airline business is exposed to several risks which are difficult to manage. These include:

(i) **The price of jet fuel**
Jet fuel prices can increase significantly over a short period of time frequently due to geopolitical issues; high fuel prices reduce airline profitability;

(ii) **Currency risk relative to the USD**
Jet fuel, aircraft rentals, and aircraft are usually priced in USD; regional airlines operating across emerging market economies are particularly vulnerable to this risk as their revenues are denominated in a basket of local currencies while a significant portion of their costs are denominated in USD; a strengthening of the USD relative to the basket of local currencies squeezes such an airline's profit margins;

(iii) **USD interest rate risk**
Aircraft tend to be financed by a significant portion of debt thus U.S. central bank tightening may in some cases lead to increased aircraft lease rental rates. However, it is emerging that some EU airlines with EUR receivables are borrowing in EUR at rates currently lower than for USD borrowings;

(iv) **Risks related to weather disruption**

(v) **Unpredictable events**
Unpredictable events disrupt passenger travel. Examples include SARS (severe acute respiratory syndrome) a potentially deadly viral infection that quickly spread around the world in 2003 and terrorist attacks.
As an example of a pandemic affecting airline travel, in 2015, an outbreak of Zika virus struck Brazil and spread to various countries in South, Central and North America. The World Health Organization declared the Zika virus a public health emergency of international concern. Several countries subsequently issued travel warnings advising passengers of the health risks of flying to countries affected by the Zika virus and as a result leisure traffic to and around the region may be adversely affected.

[16] Source: World Bank. Air passengers carried include both domestic and international aircraft passengers of air carriers registered by country. https://data.worldbank.org/indicator/IS.AIR.PSGR

In a working paper[17] published by the Federal Reserve Bank of St. Louis the authors found "*that an additional terrorist incident results in approximately a 1.2% decrease in the bilateral air passenger transport per unit distance while doubling of the accumulated terrorist incidents during the past 5 years reduces it by 18%.*"

(vi) **The level of competition between airlines**
In some regional markets, overcapacity may lead to intense competition and may push down ticket prices for flights generally thereby squeezing margins. At the time of writing[18], the Indian and European markets would be examples of this risk. Airspace, airports, and the delivery of aircraft can also affect the level of competition between airlines;

(vii) **Staff costs, disputes, and compensation systems**
For example, a series of strikes at a low-cost airline in 2018 led to hundreds of cancelled flights, increased passenger reluctance to book with the airline due to the uncertainty surrounding the timing of strikes, and increased the company's costs in terms of compensation payments to passengers for cancelled flights. Currently, there is a global shortage of pilots;

(viii) **Tax and regulatory issues**
High aviation-fuel taxes in some countries add to the cost base of airlines. In some countries, airlines may be forced to fly some loss-making regional routes to gain access to the best airport slots in that country;

(ix) **Aviation technology advances**
The introduction of aircraft capable of super-long-haul[19] flights threatens Gulf carriers that depend on passengers connecting via their hubs as their domestic air traffic is relatively small;

(x) **World or regional GDP growth**
GDP growth in part drives consumer demand for airline travel; consumer demand can change rapidly in response to unpredictable events such as those listed above or in response to changes in the economic climate; and

(xi) **Risks relating to "open sky deal"**
Brexit poses a risk to open sky agreements and may have a significant impact on the earnings of several airlines operating to and from the U.K.

According to IATA[20], from 2011 to 2014, at the aggregate level, the net profit margins of the airline industry were flat; in 2015, they increased slightly; and during 2016 and 2017 they have held firm around the 2015 level.

Over the years 2006 to 2017, net profit margins of the airline industry, ranged from a low of about -5% in 2008 to a high of about +5% in 2015.

[17] Source: FEDERAL RESERVE BANK OF ST. LOUIS; RESEARCH DIVISON, Working Paper Series. *The Effects of Terror on International Air Passenger Transport: An Empirical Investigation* by Subhayu Bandyopadhyay, Devashish Mitraand, and Cong S. Pham. Dated: May 2018.
Available at: https://research.stlouisfed.org/wp/more/2017-002

[18] August-September 2018

[19] Flights over 13,500km such as London to Perth, Manilla to New York, and Los Angeles to Singapore.

[20] IATA represents 280 airlines which account for 83% of global air traffic.

Notwithstanding the above risks, there are companies in the airline industry that are better than their competitors at managing the number and potential severity of the risks the industry faces.

Such airlines tend to have significant economies of scale and lead their competitors in the airline market in several respects including:

(i) Strong balance sheet allowing them to better weather downturns than competitors;
(ii) For the best airlines, staff cost per passenger carried are reported by airline analysts to be about one third lower than that of their competitors;
(iii) Passenger volumes help them negotiate lower fees with airports;
(iv) Ability to time the purchase of new aircraft to achieve prices that airline analysts report are up to 50% off the list price; and
(v) Load factors[21] consistently about 20% above that of legacy airlines.

Rising fuel prices will tend to knock out weaker competitors in the airline industry. By contrast, players with strong balance sheets, cost advantages such as low per-passenger staff costs and low airport fees, and high load factors are much more likely to survive such a shakeout and benefit from less competition in the market.

Some passenger airlines generate profits from purchasing aircraft directly from the manufacturers and entering into sale and lease back agreements with aircraft lessors.

Credit Ratings of Airlines

The credit ratings of the debt issued by the vast majority of passenger airlines in the world are below investment grade. According to Citibank, in the U.S. alone there have been 200 airline bankruptcies since the gradual deregulation[22] of the industry began in the late 1970s.

According to the Financial Times[23], in 2017, Monarch in the UK, Air Berlin, and Alitalia[24] went bankrupt in quick succession and, in 2018, the following European airlines went out of business: Latvia-based Primera, Cobalt of Cyprus, Germany's Azurair, Lituania's Small Planet Airlines, and Swiss SkyWork.

The debt securities of British Airways, Ryanair, Delta Air Lines, Southwest Airlines, and Westjet are among those airlines with an investment grade credit rating.

[21] Percentage of available seating capacity that is filled with passengers per flight.
[22] Prior to airline deregulation, the U.S. federal government controlled, among other things, fares, routes, and market entry of new airlines. After deregulation, airfares fell, new routes opened, passenger numbers increased, and employment in the airline industry increased.
[23] Source: ft.com. *European aviation: winter blues blow airlines off course* https://www.ft.com/content/744976f4-fb0a-11e8-aebf-99e208d3e521
[24] Alitalia is still flying with the backing of the Italian government while potentially awaiting a new owner.

8.2 Aircraft Lessors

Aircraft lessors purchase aircraft and lease them to airlines and other customers. Aircraft lessors finance the purchase of aircraft using a combination of debt and equity. The LTV ratio permitted and the interest rate charged by the lender will be significantly influenced by the estimated residual value of the aircraft being financed, the credit quality of the lessee, and whether the jurisdiction of the lessee is a contracting state for the purposes of the Cape Town Convention[25] and has implemented Alternative A of the Protocol to the Cape Town Convention. Broadly speaking, the LTV ratio permitted will be higher and the interest rate charged lower for aircraft with high estimated residual values than for aircraft with low estimated residual values. In view of the significant capital cost of aircraft, aircraft lessors tend to be indebted entities and would be likely to have several sources of fixed rate debt and employ a number of interest rate derivatives such as interest rate swaps and interest rate caps to hedge interest rate risk. Apart from banks, other sources of debt finance include private debt markets such as those in the U.S. and Germany's Schuldschein private debt market, and the issue of debt securities by aircraft lessors in public debt markets.

As aircraft lessors lease aircraft to airlines, aircraft lessors are indirectly exposed to the risks faced by airlines which are outlined earlier in this section. In recent months, the share prices of quoted aircraft lessors have modestly underperformed the S&P 500 Index possibly on concerns of shrinking airline profit margins, an absence of any meaningful recovery in lease rates, and rising interest rates.

However, aircraft leases contain what is referred to in the industry as a "hell-or-high-water" clause which is designed to ensure that the obligation of the lessee to pay rent, maintenance reserves, and all other payments will continue notwithstanding any event such as outage for maintenance, technical problems which ground the aircraft, and air traffic control restrictions arising from weather or other events beyond the control of the lessee. Lease agreements also provide for security deposits to be paid by the airline, either in cash or in the form of a letter of credit from a bank, to the lessor at the commencement of the lease; such deposits can be as high as six months' rent for airlines with poor credit ratings; airlines with strong credit ratings may pay no security deposit. For these reasons, the extent of variation in the net profits of aircraft lessors over time is believed to be lower than that experienced by airlines.

For an aircraft lessor, the substantial source of its revenue is rental payments arising from aircraft on lease. Gains on the sale of aircraft may also contribute to profits from year to year and for some aircraft lessors, fees for the management of third-party portfolios of aircraft may also contribute to profit.

[25] The Cape Town Convention is an international, private law treaty which provides owners and financiers of aircraft with some certainty as to their remedies in the jurisdictions of those countries which have ratified the convention. It is designed to reduce the risk of loss by creditors in aircraft transactions by providing protections in a manner similar to Section 1110 of the U.S. Bankruptcy Code following the bankruptcy of an airline. Individual countries can choose whether or not to ratify the convention and those countries that ratify the convention are known as 'contracting states'. Contracting states which have implemented "Alternative A" allow creditors to take possession of their aircraft after 60 days if a debtor becomes insolvent.

Expenses incurred by the lessors are generally made up of interest on debt, depreciation in the value of aircraft, and general, selling and administrative expenses. Roughly speaking, the latter expense might be of the order of 10% of total expenses with the balance split roughly equally between the other two categories.

8.2.1 Cash Flow Management, Credit Lines, and MAC Clauses

The business of aircraft leasing involves managing assets, aircraft, and managing liabilities, the debt associated with the funding of aircraft purchases. Prudent cash flow management is vital in the aircraft leasing business. The cash flows due from lessees would be continuously compared against the cash flows received and immediate action would be taken on outstanding cash flows. The legal clauses within the lease agreement relating to overdue payments are often very complex and need to be clearly understood by both parties before entering into the lease agreement.

With such a strong requirement to focus on cash flow, aircraft lessors need to have credit lines available for periods of cash flow shortfalls and to be in a position to buy assets at distressed prices when the opportunity arises. Aircraft lessors therefore need a diversified portfolio of banking relationships. Banks providing such credit lines normally do so subject to a material adverse change ("MAC") clause in the credit line agreements. There is an element of subjectivity in the interpretation of MAC clauses which may provide a way for banks to exit credit line commitments to an aircraft lessor in a crisis. Some aircraft lessors try to remove the MAC clause from credit line agreements and where they are successful in doing so they are likely to be charged a higher fee for the credit line facility.

8.2.2 Operational Issues

A key performance indicator for an aircraft lessor is perhaps the speed with which orders from airlines to lease aircraft can be executed and delivered while ensuring that every precautionary step is taken to manage the risk of the lease. The timely execution and delivery of such orders requires a very high level of team work across the sales, pricing, legal, taxation, technical, risk, with particular focus on credit risk, and portfolio management teams typically found within an aircraft lessor.

Such orders may be fulfilled through the delivery of new aircraft from the manufacturers or by delivering existing aircraft which are coming off lease from another airline. In the latter case, the aircraft may have to be deregistered in one jurisdiction and registered in another jurisdiction. Costs and delays occur if the requirements in the new jurisdiction are more stringent than in the old jurisdiction and if the return condition of the aircraft from the former lessee are materially different to the delivery condition of the aircraft to the new lessee.

8.2.3 Aircraft Lessors – Global Perspective

Aircraft lessors control something of the order of 40% of the fleet of commercial jets in the world.

According to IATA:

(i) 50% of the worldwide fleet is operated by 47 airlines with fleets of at least 108 aircraft each;

(ii) 1,000 operators run the remaining 50% with an average fleet size of 10 aircraft.

The competitors in the aircraft leasing industry include both publicly listed companies like, AerCap Holdings N.V., Aircastle Limited, and FLY Leasing Limited, and private companies like Goshawk Aviation, Japan's Orix Corporation, Avolon Holdings Corporation, and SMBC Aviation Capital. In recent years, the number of aircraft lessors funded by private equity firms has grown substantially.

As mentioned earlier, air passenger numbers have been growing at a rate of 5% per annum over the period 1980 to 2017 in part due to an expanding middle class especially in emerging markets in Asia. This growth in passenger numbers fuels demand for new routes and for new fledgling carriers in regions which were not well serviced by airline travel. Aircraft leasing has therefore experienced significant growth in recent years.

The industry is in part an intellectual capital business with a relatively low ratio of employees to revenues or assets under management. Much of the intellectual capital lies in relationships that key sales and marketing executives at aircraft lessors have nurtured over the decades with passenger airlines but also in technical staff who can carefully specify the "return from lease" conditions for aircraft and ensure compliance with those conditions by airline lessees. For investors in the aircraft lessor industry, such intellectual capital is at risk from staff turnover among key executives.

Unlike immovable property such as an office block in Manhattan, aircraft assets are inherently mobile in that sales are not restricted by geography. If say the airline industry in Europe is experiencing difficulties with aircraft having to be repossessed from airlines in Europe by aircraft lessors, it may be possible to re-lease the repossessed aircraft to an airline operating in Asia.

Aircraft operate in a highly regulated industry in terms of safety and operating procedures which helps to protect asset values.

8.2.4 Credit Ratings of Aircraft Lessors

Aircraft leasing is a cyclical business, albeit not as cyclical as the passenger airline businesses. Revenues grow during sustained periods of low fuel prices and growth in passenger numbers and vice versa. Well-funded and well-managed aircraft lessors however can benefit from downturns in the aircraft cycle by using the opportunity to purchase new aircraft at discounts believed to be up to 50% of list price from aircraft manufacturers.

Aircraft lessors make extensive use of the debt capital markets to raise finance for their operations. For that reason, compared with airlines, a greater proportion of the debt securities of aircraft lessors has an investment grade credit rating. At the time of writing, Aircastle and AerCap Holdings N.V. have some debt securities in issue with an investment grade debt rating.

9 Conclusions

Aviation debt securities offer a substantial pick up in yield for insurance undertakings and span the entire risk-reward spectrum from government guaranteed debt to mezzanine debt.

However, the ability of insurance undertakings to avail of the extra yields is hampered principally by the treatment of EETCs and ABS securitisation as Type 2 securitisations for the SCR_{SPREAD} sub-module of $SCR_{MARKETRISK}$. Unless the SCR_{SPREAD} is reduced so as to classify EETCs and ABS as Type 1 securitisations, the SCR capital charge is likely to be too high and the cost of financing the capital is likely to wipe out much of any yield premium. The Securitisation Regulation amends banks' prudential treatment (i.e. the Capital Requirements Regulation) but not that of insurance undertakings (i.e. Solvency II). Apparently, the necessary changes to the Solvency II Delegated Regulation can only be adopted after the Securitisation Regulation has been adopted. We shall have to await the implications for aviation debt securities.

Aviation debt securities are currently somewhat illiquid for inclusion to any great extent in unit-linked funds where the capital charge may be lowest and are possibly too illiquid for matching the short-term liabilities of non-life funds. There are signs that liquidity is improving as more securities are issued under Rule 144A and Regulation S of the Securities Act 1933.

The requirement of the Solvency II Prudent Person Principle to properly identify, measure, and monitor the risk of assets, probably limits investment to only the most sophisticated asset management arms of insurance undertakings or, where asset management is outsourced the more sophisticated larger bond fund management firms, which can model the cash flows underlying such securities.

10 Appendix 1

10.1 Overview of Certain Elements of Solvency II

10.1.1 Solvency Capital Requirement: Standard Formula v. Internal Model

Solvency II regulations define SCR as the level of capital that insurance undertakings are required to hold for regulatory purposes. The SCR is set at the level of capital that would be required for the entity to withstand a 1 in 200-year risk event over a one-year time horizon. Firms may be at risk of a capital add on if their regulator deems that the SCR is not reflective of the level of risk to which the firm is exposed.

The calculation of the SCR can be performed using either a standard formula or by using a bespoke internally developed capital model which has been approved by the insurance undertaking's regulator. The standard formula is a pre-defined calculation using prescribed parameters which are set by the European Insurance and Occupational Pensions Authority ("EIOPA"). If an insurance undertaking adopts the standard formula for calculating its SCR, there is a regulatory requirement for the insurance undertaking to assess the appropriateness of the use of the standard formula in determining the insurance undertaking's capital requirement.

If an insurance undertaking determines that the standard formula is not a fair representation of the risks it faces, it may develop their own capital model ("internal model") to calculate the SCR. The use of such an internal model in calculating the undertaking's SCR is subject to regulatory approval. Where the standard formula is not a fair representation of the risks faced, an internal model ought to result in an SCR that more accurately reflects the risk being undertaken by the insurance undertaking. For example, the standard formula may not adequately allow for non-proportional reinsurance arrangements or products with guarantees.

Where an insurance undertaking uses an internal model, it must be approved by the undertaking's regulator prior to its use in determining the insurance undertaking's SCR. The development and approval of an internal model can be a costly and time-consuming process. As a result, many insurance undertakings choose to use the standard formula to calculate their SCR. This may have a subsequent impact on decisions such as the type of reinsurance selected and on the choice of investments. If an investment is likely to give rise to a very high SCR under the standard formula, then an insurance undertaking may exclude such investments from its investment universe.

Internal models are more likely to be used by large insurance groups due to economies of scale in the development of the models and due to the nature and spread of the risks borne by these insurance undertakings. Internal models may also be used by some smaller insurance undertakings where it would be inappropriate to use the standard formula to assess the insurance undertaking's SCR as the standard formula would not accurately reflect the risks underlying the business.

The detail underlying the formulas and calibration of an insurance undertaking's internal model is proprietary knowledge and therefore the level of capital that would be required for specific investments would not generally be publicly available unless an insurance undertaking discloses such information. This presents both challenges and opportunities for those seeking to sell investments to insurance undertakings. The seller will not know whether the investment is likely to be capital intensive for the insurance undertaking. This represents a challenge to the seller. However, it is possible that an investment that may have a high SCR for an insurance undertaking subject to the standard formula, may have a lower capital charge for some insurance undertakings with internal models. This represents an opportunity for the seller of aviation debt securities, but the challenge is to find the insurance undertakings with internal models which assign a low capital charge to such debt securities.

10.1.2 Spread Risk Submodule within Market Risk

Spread risk is the sensitivity of the values of assets and liabilities to changes in the level or in the volatility of credit spreads over the risk-free interest rate term structure. Spread risk assumes that spreads will increase on all instruments in a 1 in 200-year event.

Spread risk is calculated using the following formula:

$$SCR_{SPREAD} = SCR_{BONDS\ AND\ LOANS} + SCR_{SECURITISATION} + SCR_{CREDIT\ DERIVATIVES}$$

Note that the spread risk formula has no allowance for diversification between the three components.

$SCR_{BONDS\ AND\ LOANS}$, the capital requirement for spread risk on bonds and loans, is equal to the loss in the own funds that would result from an instantaneous relative decrease in the value of each bond or loan. The assumption is made that the spreads on all instruments increase, leading to an instantaneous reduction in the value of bonds.

The $SCR_{BONDS\ AND\ LOANS}$ formula depends on: (i) a combination of the modified duration of the bond or loan, subject to a minimum duration of 1 year; and (ii) its credit rating. The formula is different for those bond and loans which have a credit rating from a nominated External Credit Assessment Institution ("ECAI") than for those without such a rating. The formula provides for a reduction in SCR for such bonds and loans where there is collateral posted with the insurance undertaking and where the collateral meets certain criteria.

For the collateral to qualify it must meet several qualifying criteria, such as the legal enforceability of the collateral arrangements, the establishment of a direct claim on the collateral in the event of a default on the bond or loan and that there is no double counting of the collateral for capital calculation purposes. In addition, the collateral arrangement must be in force for at least the next 12 months to be fully qualifying, and if not, then the impact must be proportionately reduced. The collateral must also provide for an effective transfer of risk, meaning that it does not create other risks to the insurance undertaking or that there are not connected transactions that undermine the transfer of risk. There are further detailed requirements for the collateral to be qualifying such as sufficient certainty as to the protection achieved by the collateral, the requirement for no material positive correlation between the credit quality of the counterparty and the value of the collateral, and that the collateral is not securities issued by the counterparty or a related company.

Consider for example a bond with a modified duration of 15 years. The following is the spread risk factor for different S&P credit ratings, expressed as a percentage of the value of the bond:

1) AAA credit rating: 9.5%
2) BBB credit rating: 25%
3) BB credit rating: 44%
4) No credit rating, no collateral: 29.5%
5) No credit rating, with collateral meeting specified conditions: 14.75%

There are lower capital requirements for covered bonds. The underlying assumption is that a pool of assets of high credit quality covers the bond and therefore the shock factors for covered bonds should be somewhat aligned with the shocks for bond exposures with credit ratings of AAA or AA.[26]

$SCR_{SECURITISATION}$, the capital requirement for spread risk on securitisations, is calculated separately for Type 1 securitisations and Type 2 securitisations. Article 177 of the Solvency II Delegated Acts sets out detailed requirements for determining Type 1 and Type 2 securitisations. Type 1 and type 2 securitisations are discussed further in Appendix 3.

The securitisation spread risk is the modified duration of the securitisation position multiplied by a risk factor, which is based on the credit rating and the type classification of the securitisation.

For example, the spread risk for a BBB rated Type 1 securitisation with a 5-year duration is 15% whereas the spread risk for a BBB rated Type 2 securitisation with a 5-year duration is 98.5%. Type 1 securitisation positions which are fully, unconditionally and irrevocably guaranteed by the European Investment Fund or the European Investment Bank, where the guarantee meets certain criteria, are assigned a spread risk capital charge of 0%.

$SCR_{CREDIT\ DERIVATIVES}$, the capital requirement for credit derivatives, is calculated as the higher of the following:

a) The loss in basic own funds that would result from an instantaneous increase in absolute terms of the credit spread of the instruments underlying the credit derivatives. The increase varies with the credit rating of the credit derivative as per Table 3 below. If the credit derivative does not have a credit rating, then an increase in credit spread of 5 percentage points is used.
b) The loss in the basic own funds that would result from an instantaneous relative decrease of the credit spread of the instruments underlying the credit derivatives by 75%.

Table 3

Credit Quality Step	0	1	2	3	4	5	6
Increase in Spread (in percentage points)	1.3	1.5	2.6	4.5	8.4	16.2	16.2

[26] The underlying assumptions in the standard formula for the Solvency Capital Requirement Calculation, https://eiopa.europa.eu/Publications/Standards/EIOPA-14-322_Underlying_Assumptions.pdf

The following exposures are examples of securities assigned a spread risk capital charge of 0%:

- the European Central Bank;
- Securities issued by European Member States' central government and central banks and denominated and funded in the domestic currency of that central government or the central bank;
- Multilateral development banks such as the International Bank for Reconstruction and Development and the International Finance Corporation; and
- International organisations such as the IMF and Bank for International Settlements.

A list of securities assigned a spread risk capital charge of zero is set out in Articles 117 and 118 of Regulation (EU) No 575/2013.

10.1.3 Concentration Risk Submodule within Market Risk

Overview

The concentration risk sub-module of market risk covers exposures to undertakings which belong to the same corporate group and treats such exposures as exposures to a single name (a "Name"). Concentration risk is confined to the risk regarding the accumulation of exposure with the same Name and does not include other types of concentration risk, such as geographical or sector concentrations. Concentration risks such as geographical and sector concentration risks would be considered under Solvency II Prudent Person Principle.

The standard formula model specifies a formula for quantifying the exposure to concentration risk and the capital charge associated with that risk. The underlying assumption in the concentration risk sub-module is that when the undertaking has exposure to a Name that is above pre-defined excess exposure thresholds, the undertaking is at risk if the Name defaults. Hence the undertaking is required to hold capital to cover that risk. If the undertaking's exposure to a Name is below the specified thresholds, the undertaking is deemed to be not at risk, and there is no capital requirement for concentration risk in respect of that Name.

The calibration of the market risk concentration risk sub-module is based on the principle that the volatility and hence risk associated with an undiversified portfolio is higher than that for a well-diversified investment portfolio.

To calculate concentration risk, the total exposure to individual Names are grouped together and expressed as a percentage of the insurance undertaking's total assets, where the total assets exclude certain items, for example, intangibles, deferred tax assets, and reinsurance recoveries.

If the total net exposure to a Name expressed as a percentage of total assets is greater than a prescribed threshold then the excess over the threshold is defined to be at risk under the concentration risk module.

The total exposure to an individual Name includes both direct and indirect exposures. For example, exposures to a Name through an investment fund are included by assessing the exposure on a look-through basis.

Calculation of Concentration Risk

Calculation Parameters for Individual Names

The concentration risk sub-module of market risk uses a formula based on total exposure to a Name and the associated credit quality of the Name. The calculation of the concentration risk for a particular Name is based on two metrics, as follows:

I. The excess exposure to the individual Name, XS_i, is dependent on the credit rating of the Name:
   - Where the S&P credit rating is A or above, the excess exposure threshold is 3% of the undertaking's total assets[27]. Where the credit rating is lower than A the threshold is 1.5%;
   - The credit rating used is from a nominated ECAI and where a company has multiple credit ratings the second highest rating is selected;
   - The exposure to a Name may be the combination of exposures through different asset holdings (i.e. debt, investment fund, etc.). In this case, the credit rating used for calculation purposes is the rounded-up, weighted average of the individual credit ratings.

II. The risk concentration capital charge per Name, g_i, is then calculated as follows:
   - The excess exposure is multiplied by a risk factor for each individual Name;
   - Risk factors are based on the credit rating of the Name, based on a scale as follows:
     - 12% for AAA and AA rated exposures;
     - 21% for A rated exposures;
     - 27% for BBB rated exposures; and
     - 73% for below BBB and unrated exposures.

Exposures to an insurance undertaking for which a credit rating is not available, and where the undertaking meets its minimum capital requirement, are assigned a risk factor using a prescribed scale based on the undertaking's underlying Solvency II coverage ratio. The scale starts at a risk factor of 73% for Solvency II coverage ratios of 95% and below and has a minimum of 12% for Solvency II coverage ratios of 196% and above.

Calculation and Aggregation

The market risk concentration for each individual Name is calculated by multiplying the excess exposure to the Name and the risk concentration charge for that Name, $Conc_i$, as follows:

$$Conc_i = XS_i * g_i$$

The total concentration risk for the undertaking is calculated as the square root of the sum of squared concentration risk charge for each individual Name, as follows:

$$SCR_{conc} = Sqrt\ (\sum Conc_i^2)$$

The aggregation calculation implicitly assumes that the risk arising from the concentration to an individual Name is independent of the risk from concentrated exposures to other names.

[27] Total assets as noted in overview section

Names with Specific Treatment for Concentration Risk Calculation

Exposures to one of the following Names, or those Names that are irrevocably guaranteed by one of the following, have a concentration risk capital charge of 0%:

- The European Central Bank
- Central government and central banks of EU Member States
- Multilateral development banks
- International organisations such as the following:
    - European Union;
    - The International Monetary Fund;
    - Bank for International Settlements;
    - European Financial Stability Facility;
    - European Stability Mechanism; and
    - An International financial institution established by two or more Member States, which has the purpose to mobilise funding and provide financial assistance to the benefit of its members that are experiencing or threatened by severe financing problems.

Exposures to other central governments and central banks have a risk factor of zero if they have a high credit rating of AA or above. Subject to meeting certain criteria, bank deposits covered by a European Union government guarantee scheme have a risk factor of zero.

Covered bonds are assigned an excess exposure threshold of 15%, where bonds are issued by a credit institution which has its registered office in a European Union Member State and is subject by law to special public supervision designed to protect bond-holders.

Look Through Approach

When calculating the SCR, undertakings are required to apply a look-through approach. This means that when assessing the exposure of an undertaking to an asset class or to an individual Name, indirect exposures through investment in the underlying assets of collective investment undertakings and other investments packaged as funds must be identified and included in the risks being considered.

Where the look-through approach cannot be applied, for example, where information is not available, the SCR may be calculated using the target underlying asset allocation of the collective investment undertaking or fund subject to certain conditions. The conditions include that a target allocation is available to the undertaking at the level of granularity necessary for calculating all relevant sub-modules and scenarios of the standard formula, and the underlying assets are managed strictly according to this target allocation.
For the purposes of that calculation, data groupings may be used, provided they are applied in a prudent manner, and that they do not apply to more than 20% of the total value of the assets of the insurance undertaking.

There are further detailed EIOPA guidelines on the treatment of look-through where exposures are not clearly identifiable however these are not covered in this paper.

10.1.4 Diversification

The capital charge associated with most of the risk modules are aggregated together to calculate the undiversified capital requirement. However, a diversified portfolio of risks ought to have a lower risk profile compared to an undiversified portfolio of risks as an adverse outcome from one risk is likely to be offset by a more favourable outcome from another risk where the risks are not fully correlated. The Solvency II standard formula reduces the capital charge to reflect the diversification of risks.

Diversification across the Market Risk Sub-Modules

The individual market risk sub-modules are calculated according to the Solvency II specifications. However, the total market risk is not simply the aggregate of the market risk arising from each individual market risk sub-module. Instead, the market risk is calculated according to a formula which assumes that the individual market risk sub-modules are not fully correlated.

The correlations between each individual market risk sub-module are set out in Table 4 below.

Table 4

Market Risk	Interest Rate	Equity	Property	Spread	Concentration	Currency
Interest Rate	1	A	A	A	0	0.25
Equity	A	1	0.75	0.75	0	0.25
Property	A	0.75	1	0.5	0	0.25
Spread	A	0.75	0.5	1	0	0.25
Concentration	0	0	0	0	1	0
Currency	0.25	0.25	0.25	0.25	0	1

The parameter A is equal to 0 where the capital requirement for interest rate risk is based on an increase in interest rates and is equal to 0.5 where the capital requirement for interest rate risk is based on a decrease in interest rates.

The different sub-modules of SCR[28] are aggregated using the correlation parameters in Table 5 to allow for the diversification across the risk sub-modules and to arrive at the overall SCR.

The overall SCR for an insurance undertaking is the sum of: (i) the Basic Solvency Capital Requirement ("BSCR"); (ii) an operational risk sub module; and (iii) certain other adjustments.

$$BSCR = Sqrt \{\sum[Corr_{ij} * SCR_i * SCR_j]\} + SCR_{intangibles}$$

Where:

$Corr_{ij}$ is taken from the correlation matrix in Table 5 below
SCR_i is the SCR from the risk module i
SCR_j is the SCR from the risk module j

This calculation is done where i and j represent each of the following SCR risk modules:

1) Market Risk
2) Counterparty Default

[28] Market Risk, Counterparty Default, Life Underwriting, Health Underwriting, and Non-Life Underwriting.

3) Life Underwriting
4) Health Underwriting
5) Non-Life Underwriting

Table 5 shows correlations between the SCR sub-modules to be used in the formula:

$$\text{Sqrt}\ \{\sum[Corr_{ij} * SCR_i * SCR_j]\}$$

Table 5

Correlation Matrix	Market Risk	Counterparty Default	Life Underwriting	Health Underwriting	Non-Life Underwriting
Market Risk	**1**	**0.25**	**0.25**	**0.25**	**0.25**
Counterparty Default	**0.25**	**1**	**0.25**	**0.25**	**0.5**
Life Underwriting	**0.25**	**0.25**	**1**	**0.25**	**0**
Health Underwriting	**0.25**	**0.25**	**0.25**	**1**	**0**
Non-Life Underwriting	**0.25**	**0.5**	**0**	**0**	**1**

From Table 5, we note that the market risk SCR is at least 25% correlated with the other risk modules.

Impact of Diversification

The Solvency II calculations effectively give credit to those insurance undertakings that have a well-diversified portfolio of risks.

10.2 Non-Capital Considerations

10.2.1 Asset Liability Management ("ALM")

In the same way that aircraft lessors have assets such as aircraft and liabilities such as loans to finance the aircraft, insurance undertakings are liability driven businesses with assets purchased to back the expected liability outgo under their portfolios of policies and own funds. In the case of insurance undertakings, the selection and management of these assets is critical. There are numerous factors to be considered when selecting appropriate assets including: duration risk, credit risk, currency risk, counterparty risk, market risk, expected return, liquidity, volatility, accounting treatment, and Solvency II capital charge.

The purpose of ALM modelling is to assess the extent to which the cash flows under stressed conditions will support the payments due under the insurance undertaking's liabilities to policyholders. ALM modelling provides insights into how well the assets and the liabilities are matched under various scenarios. Insurance undertakings project the expected cash flows of both their asset and liability portfolios as part of their capital management framework. These projections are done on a regular basis and may be done on an ad hoc basis where there has been or there is expected to be a significant change in the assets, liabilities or the business environment. The projections may be performed either on a deterministic or stochastic basis.

Some insurance undertakings will have long-term liabilities, for example, a life insurance undertaking writing annuity business whereas others will have short-term liabilities, for example, a non-life insurance undertaking writing household and motor insurance. The selection criteria for choosing assets to match liabilities that these two insurance undertakings would use may be very different.

Purchasing assets that have a shorter term to maturity than the liability profile introduces reinvestment risk as the maturity proceeds of the assets will have to be reinvested on unknown terms.

Illiquid assets may be appropriate for matching long-term, annuity contracts. However, they are likely to be inappropriate for matching the claims arising on short-term household and motor policies because they are unlikely to be realisable at or close to their recent market value at short notice in times of market stress.

If an insurance undertaking were considering purchasing investments in a new asset class or investing a significant portion of its assets in an existing asset class, it would in all likelihood conduct asset, liability, and SCR projections and examine the impact on its reported IFRS profits to assist in the investment decision.

11 Appendix 2

11.1 Export Credit Agencies

ECAs are government agencies that provide financial support for the export of goods manufactured in the ECA's home state. The purpose of ECAs is to provide support for the export of goods manufactured within the ECA's economy to buyers in other countries.

Table 6 below lists a number of countries and their ECAs.

Table 6

Country	ECA
United States of America	EX-IM Bank
France	Bpifrance
Germany	Euler Hermes
Italy	SACE
United Kingdom	U.K. Export Finance
Spain	CESCE
Canada	EDC
Brazil	BNDES
China	Sinosure and CEXIM

The form of financial support for exports given by an ECA depends on the mandate given to it by its government. In the case of aircraft, the ECA support generally takes the form of guarantees for loans made by lenders to overseas purchasers of aircraft which are manufactured in the home state of the ECA.

The ECA's client is the aircraft manufacturer. The aircraft manufacturer informs its potential customers that ECA support may be available subject to certain conditions to help facilitate the purchase of the manufacturer's aircraft. There is a duty on the borrower to disclose all material facts to the ECA.

For an airline wishing to borrow to purchase an aircraft, ECAs provide access to finance when the private sector is unwilling or unable to do so; for example, during times when there is a lack of liquidity in the aircraft financing market.

In most cases, only 15 per cent of the cost of the aircraft will have to be financed outside of the ECA supported lending. However, there is little scope for the airline to negotiate terms with an ECA as most of the rules regarding ECA support are set out in the Aircraft Sector Understanding developed by the Organization for Economic Cooperation and Development ("OECD"). At the time of writing, ECA finance for the purchase of aircraft is relatively expensive.

For an ECA to provide support for the sale of an aircraft, a certain percentage, around 20 per cent of the value of the aircraft, must have been manufactured in that ECA's home state.

Airbus SE is a publicly-quoted, European aerospace company which is registered in the Netherlands and which, at the time of writing, is a constituent of the EURO STOXX 50® index. The governments of France and Germany each own approximately 11% of Airbus.

Airbus designs, manufactures, and sells civil and military aerospace products worldwide. Although it has civil aviation manufacturing facilities in the U.S. and China, the manufacturing facilities are based predominantly in France, Germany, Spain, and the U.K. The wings for Airbus aircraft are made in the U.K. and sometimes Rolls Royce makes the engines, so the U.K. content may vary from 20 per cent to 40 per cent depending on whether Rolls Royce engines are fitted to the aircraft.

In the case of an Airbus aircraft, Bpifrance, Euler Hermes, and the U.K. Export Finance would provide support to lenders for a syndicated loan in respect of the portion of the aircraft manufactured in France, Germany, and the U.K. respectively. An agent is appointed to manage the entire deal as in this example there are three tranches of loan, one associated with each ECA guarantor.

Table 7 compares the principal features and requirements of bonds guaranteed by two different ECAs, EX-IM Bank and the European ECAs.

Table 7

Comparison Heading	EX-IM Bank	European ECAs
Listing	Not listed	Listed on a Regulated Market
Requirements to Call the Guarantee	May not be made until 15 days after notice of non-payment has been served on issuer and must be made within 150 days of the due date of the defaulted payment	Guarantee demand may be made at any time after the defaulted payment
Payment Date	The defaulted payment must be over 45 days from due date; guarantee payment within 15 business days of receipt of demand	Guarantee payment on later of (i) 15 business days of receipt of demand; and (ii) 60 days after due date of relevant payment
Amount Guaranteed	Principal and scheduled interest unpaid on due date; in addition, scheduled interest up to date of actual guarantee payment is paid	Principal and scheduled interest unpaid on due date; in addition, scheduled interest up to 60 days after payment default
'Make whole' Premium[29]	Payment of "make whole" premium is not guaranteed; EX-IM Bank will always pay on scheduled basis for USD financings so no there is prepayment issue	May pay on scheduled or accelerated basis in which case "make whole" premium is guaranteed
Disclosure Requirements in relation to bonds issued	US Securities Act – Rule 144A issuance – Section 3(A)(2) disclosure exemption for US government paper	Within the EU, bonds are exempt from disclosure requirements under Article 1(2)(d) of the Prospectus Directive as they are guaranteed by one or more Member States

ECA finance is an expensive form of finance; for many airlines, it is a 'last resort' form of finance and is rather restrictive in nature.

A typical ECA financing structure for the purchase of an aircraft will involve a loan of circa 85 per cent of the net price of the aircraft being advanced by a syndicate of ECA banks to a bankruptcy-remote SPV as owner and lessor of the aircraft. The remaining 15 per cent of the net price of the aircraft may be paid for by an entity of substance or borrowed from commercial lenders. In the latter case, the loan will be subordinate to the syndicated, export-credit-agencies-backed loan. The owner and lessor will then lease the aircraft to an airline.

[29] A make-whole premium ensures that the investor receives a lump sum payment for the net present value of all the future cash flows of the bond as agreed upon within the indenture.

11.1.1 Aircraft Sector Understanding

The Aircraft Sector Understanding arose out of OECD guidelines for export credit arrangements operated by the OECD[30] member states with the aim of ensuring that competition was based on the price and quality of the goods rather than on which ECA could offer the most favourable financial terms and other conditions. The Aircraft Sector Understanding was designed to create a level playing field for ECAs and to provide clarity for borrowers.

The Aircraft Sector Understanding is a 'gentleman's agreement' between participating states as to what ECAs can support, how that support is given, and at what cost. The aim is to create a level playing field between export credit agencies. The Aircraft Sector Understanding does not have the force of law.

For direct lending, the current minimum interest rate that may be charged by an ECA is LIBOR for floating rate loans and the 7-year swap rate for 12-year fixed rate loans. The maximum repayment term for all aircraft is 12 years but this may be increased to 15 years on an exceptional basis with prior notification and a 35 per cent surcharge on the minimum premium rate ("MPR"). Repayment is to be made quarterly. Semi-annual payment may be offered with a surcharge of 15 per cent on the MPR.

Under the Aircraft Sector Understanding a list of borrowers and which of eight credit risk categories they fall into is published every 12 months.

The Aircraft Sector Understanding terms for support depend upon among other things: the category of aircraft, the term of the loan, the amount that may be lent, the premium payable for the facility, the security package, and the form of support, for example, guarantee or direct lending.

Key Principles of the Aircraft Sector Understanding

The maximum support that an ECA may offer is based on 85 per cent of the net price of the aircraft.

The standard maximum term is equal to 12 years. Up to 15 years may be negotiated subject to a surcharge of 35 per cent of the premium.

In terms of security, there must be a mortgage over or other security interest in the aircraft, assignment of lease rentals, and cross collateralisation and cross default with respect to other ECA financings.

The premium charged by the ECA in return for supporting the financing varies with the type of borrower and the Aircraft Sector Understanding sets out minimum pricing for different types of borrower based on the borrower's credit rating. Airlines with stronger credit ratings pay a lower premium than those with poorer credit ratings. However, to discourage the best credits from seeking ECA support, the best credits can only obtain 80 per cent support.

[30] http://www.oecd.org/trade/xcred/aircraftsectorunderstandings.htm

Capital Markets Backed ECA Transactions

In capital market backed ECA transactions, bonds are issued to investors in return for cash which is used to finance the purchase of aircraft. A security trustee holds the security package and the ECA provides a repayment guarantee to the bond holders.

The proportion of ECA-backed bonds is likely to continue to grow as new structures challenge conventional vanilla debt financing. In addition, ECA supported capital markets products permit greater scale, five to ten aircraft may be financed through a single issue; investor appetite for such bonds is growing, and the pricing of such bonds is very competitive.

Bonds issued to investors via the capital markets are attractive to borrowers because they can lock in an attractive fixed rate of interest. By contrast, bank loans tend to be offered at a premium above LIBOR.

As ECA guaranteed bonds carry a government agency guarantee, they are attractive to institutional investors from a risk and return perspective and because, for some institutional investors such as banks, ECA guaranteed bonds do not attract a capital charge under the Capital Requirements Directive.

Parties to a Typical ECA Structure

The borrower or lessor will normally be a bankruptcy remote SPV, commonly established in jurisdictions such as the Cayman Islands or Ireland as an "orphan" SPV. However, the structure may need to be adapted for tax efficiency.

The airline or lessee assigns its rights to purchase the aircraft to the SPV and the airline or lessee bears the structural risk of the transaction in that it provides the "flow through indemnity" which ensures that the ultimate recourse is to the airline rather than the bankruptcy-remote SPV.

The lender advances a loan of up to a maximum of 85 per cent of the net price of the aircraft. The security trustee holds the security, the aircraft and the assignment of the lease receivables, for the ECA. The ECA issues the guarantee to the lender. Commercial lenders, where applicable, may advance the remaining 15 per cent of the purchase price to the airline or lessee as a loan subordinate to the ECA guaranteed loan.

11.1.2 Reasons for the Current Decline of ECA Supported Financings

Between 2009 and 2012, ECA supported financing accounted for about 30 per cent of the finance of new aircraft; by 2015 this had dropped to about 6 per cent of deliveries.

Table 8 below sets out possible reasons for the decline in ECA supported finance.

Table 8

Reason	Comment
Supply of Alternative Cheaper Sources of Finance	There has been an increase in the availability of commercial debt and other funding sources such as the capital markets and operating lessors.
Rise in the cost of ECA Premiums due to the Aircraft Sector Understanding	ECA premiums have risen because of the Aircraft Sector Understanding making it more expensive compared with other sources of finance. Recall, the premium charged by ECAs in return for supporting the financing varies with the type of borrower and the Aircraft Sector Understanding sets out minimum pricing for different types of borrower based on the borrower's credit rating.
Aircraft Sector Understanding Discouraging the Airlines with the Best Credit Ratings	Airlines with stronger credit ratings pay a lower premium than those with poorer credit ratings. However, to discourage the best credits from seeking ECA support, the best credits can obtain only 80 per cent of the net price of the aircraft in terms of support.
Political Issues	In the US, EX-IM Bank requires Congressional Reauthorisation before it can realistically support financing transactions. Regarding the European ECAs and Airbus, Airbus is the subject of anti-corruption investigations[31] during which no ECA financing will be made available to Airbus.

ECA financing is not going away, but dependence on it is likely to reduce. When the next credit crunch comes, ECA financing may again become relatively more attractive.

[31] Source: https://www.theguardian.com/business/2017/nov/04/airbus-year-corporate-confessions-difficult-landing. In November 2017, The Guardian newspaper reported that: (i) The UK Serious Fraud Office is probing allegedly misleading statements made by Airbus to UK Export Finance ("UKEF") and that it is understood that Airbus has not received any further support from UKEF since it was informed of the allegations in April 2016; and (ii) the French equivalent of the SFO, is probing the same allegations and that France's and Germany's export credit agencies are also investigating the extent of the problems.

11.2 Enhanced Equipment Trust Certificates

Before proceeding to examine a EETC, let's examine briefly the nature of an equipment trust certificate ("ETC"). In the context of aviation debt, an ETC is a debt security issued by a trust to investors who subscribe debt capital to finance the purchase of an aircraft[32] by the trust for onward lease to an airline.

Lease payments by the airline are used to service the payments under the trust's debt securities.

The value of an aircraft depreciates over time so to ensure that the residual value of the aircraft is greater than the debt outstanding under the debt securities, the term to maturity of an ETC is usually significantly shorter than the expected life of the aircraft. The expected life of a commercial aircraft is of the order of 25 years whereas the term of ETCs is of the order of 10 to 12 years.

Legal title to the aircraft remains with the trustee of the trust for the benefit of the bondholders until the debt has been repaid at which point title to the aircraft passes to the airline. As legal title to the aircraft does not pass to the airline until the debt is repaid, the aircraft is not considered to be the property of the airline. It is therefore not available as an asset to the creditors of the airline should the airline becomes bankrupt. Typically, a bank will act as the trustee of an ETC.

From an accounting perspective, the lease is more in the nature of a finance lease than an operating lease as the airline receives title to the aircraft at the end of the lease. While the use of ETCs is in essence a form of secured debt financing similar to a mortgage one might well ask why an ETC structure might be used rather than a mortgage. In the United States, ETCs enjoy certain tax benefits compared with mortgages.

11.2.1 From ETC to EETC

A EETC is similar to an ETC but carries enhanced creditworthiness from the perspective of the debt security holders. There are a number of major differences between an EETC and an ETC:

1. The debt security of an EETC is divided into at least two classes of debt security. Each class has different payment priorities and different claims over the collateral in the event of a winding up of the trust. The LTV ratio for the highest rated class of debt securities would be significantly less than one (1) thereby pushing the risk of default down to the lower classes and ultimately to the most subordinated class of investors in the structure. An investment-grade credit rating may be obtained for the class of debt securities with the highest payment and asset claim priorities.
   The creation of different classes of debt security allows the issuer to target investors seeking high-yield and investors with credit rating restrictions on the debt securities they may purchase under their investment guidelines. EETCs usually provide that a default by the airline on any payment obligation under the EETC will trigger a default with respect to all aircraft that secure the EETC. Thus, subject to subordination

[32] Aside from financing the purchase of aircraft, ETCs may be used to finance the purchase of other assets such as railroad cars and ships.

agreements between the different classes of investors, all proceeds of aircraft equipment collateral are available to all investors if there is a default by the airline on any one obligation; EETCs generally offer a liquidity facility[33] to provide for the continued payment of interest on the EETCs following the default of a lessee during the period when the aircraft underlying the EETC is or are being repossessed to recover the principal or in some cases to permit the remarketing of the aircraft to another lessee.

2. Debt security holders want certainty around the timeframe under which they may repossess and remarket their collateral if the airline defaults on its payment obligations. Section 1110 of the U.S. Bankruptcy Code provides predictable access to aircraft equipment within 60 days in the event of a U.S. airline bankruptcy.

3. The loan-to-value ratio is generally less than one (1) or put another way, the value of the aircraft collateral exceeds the value of the payments due under the EETC thereby providing investors with some protection against a reduction in the value of the collateral pool and a margin to cover recovery costs.

These major differences between ETCs and EETCs allow EETC debt securities to have better credit ratings than the corporate credit rating of the lessee and hence permit the financing of aircraft at a lower cost than if airline financed the aircraft using corporate debt.

According to a research report entitled "*EETC Historical Recoveries and Current Outlook*" by KBRA dated September 2015, *"historical data show that EETCs have a much lower probability of default than airlines indicating that the EETC structure has successfully de-linked airline credit risk from EETC performance"*.

The report also states, *"EETC losses are extremely low despite the number of airline bankruptcies since the product's inception in 1994, with cumulative loss rates over the past 20 years ranging from 0.1%-3.0%; minimal realized losses suggest that EETC ratings have been too low historically"*.

The report attributes the high recovery rates on EETCs in bankruptcy to Section 1110 protections, strong collateral, and structure of EETCs.

A number of non-U.S. airlines have issued EETCs by relying on Alternative A of the Protocol to the Cape Town Convention[34] which is similar to the 'creditor friendly' Section 1110 of the U.S.

[33] The liquidity facility generally takes the form of an undrawn bank loan which will cover interest due on the EETCs for a limited period in the event of a default by the airline or the issuer.

[34] The Cape Town Convention is an international, private law treaty which provides owners and financiers of aircraft with some certainty as to their remedies in the jurisdictions of those countries which have ratified the convention. It is designed to reduce the risk of loss by creditors in aircraft transactions by providing protections in a manner similar to Section 1110 of the U.S. Bankruptcy Code following the bankruptcy of an airline. Individual countries can choose whether or not to ratify the convention and those countries that ratify the convention are known as 'contracting states'. The Cape Town Convention has made it possible to expand the EETC structure beyond U.S. air carriers.

Bankruptcy Code in permitting speedy access to aircraft equipment following airline insolvency.

Turkey has chosen to implement Alternative A of the Protocol to the Cape Town Convention. The Cape Town Convention prevails over national insolvency laws in Turkey. Turkish Airlines issued $328 million[35] as part of its first EETC in March 2015 to financing three Boeing 777. Thus, it is anticipated that in the case of an insolvency-related event in respect of Turkish Airlines, the legal protections afforded by the Cape Town Convention would be available. Other non-US issuers of EETCs include Emirates and Air Canada.

It would be unwise to extrapolate the historical loss rates of US EETCs to non-U.S. issuers of EETCs as the apparently equivalent US Section 1110 protections embedded in these structures have not been tested in the courts of the relevant jurisdictions.

11.2.2 Performance of EETCs in Stressed Markets

Between 2001 and 2011, in the U.S., almost every major airline EETC issuer filed for bankruptcy[36]. However, according to a study by KBRA, loss rates on interest and principal of "A" tranche EETC debt securities were less than 0.5% regardless of the issuer or its cash flow-generating ability. KBRA assert that '*The primary contributor to this outcome has been the importance of the assets to the airlines' operating strategy during and after bankruptcy, which resulted in affirmation of aircraft collateral in most cases.*'

EETCs and Irish Stamp Duty

Since the passing of Finance Act 2013 in Ireland, EETCs are exempt from stamp duty on their issue, transfer or redemption.

11.3 Aviation Asset-Backed Securities

An ABS transaction provides a means for an aircraft lessor to move aircraft off its balance sheet and has been used by lessors to sell mid-life[37] and end-of-life aircraft. Aircraft ABS were first issued in the early 1990s.

There are at least two incentives for lessors to securitise their aircraft and aircraft leases:

(i) To remove risky assets from their balance sheet by having another entity, the SPV, assume the valuation risk[38] of aircraft and the credit risk of the lessees to which the aircraft are leased;

(ii) To improve the credit rating of the lessor's debt by moving older[39] and perhaps more difficult to value aircraft into a securitisation structure.

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[35] Source: https://www.flightglobal.com/news/articles/turkish-launches-long-awaited-eetc-for-three-777s-410362/

[36] Source: Aviation Finance. http://www.aviationfinance.aero/articles/14995/EETC-performance Accessed 8 November 2018.

[37] Generally, aircraft between 6 and 18 years old.

[38] As at September 2018, the valuations of twin-aisle jets are weakening while those of single-aisle, modern aircraft are relatively stable.

[39] Older aircraft are subject to technological obsolescence, incur higher maintenance costs, are more difficult to lease and have greater uncertainty surrounding their value than newer aircraft.

Lessors receive cash in return for the securitisation of part of their portfolio of aircraft and associated leases. This allows lessors to use the capital generated by securitisations for a number of potential purposes such as: (a) purchase new aircraft; (b) reduce the debt and thereby lower the leverage of the lessor's business; or (c) increase the credit rating of the lessor. In addition, where the lessor acts as the servicer to the securitisation SPV, it generates ongoing revenue in the form of a service fee while having little or no economic exposure to the assets underlying the SPV.

Interestingly, only a very small number of debt securities arising from securitisations by aircraft lessors have a credit rating in excess of A and the credit rating agency one comes across frequently in this specialist market segment is KBRA. The average age of the aircraft in the SPV is a major determinant of the rating that debt securities issued by the SPV will receive from the credit rating agencies.

The credit rating of the senior unsecured debt of the largest aircraft leasing companies in the world is typically just above or just below investment grade debt. For example, certain senior unsecured debt of Aercap Holdings was rated BBB- by S&P[40]. BBB- is the lowest credit rating within the S&P investment grade category.

As of September 2018, it is relatively easy for aircraft lessors to raise finance to purchase new aircraft for onward leasing to airlines. This is due to the strong competition among the various sources of finance which include commercial bank lending, capital markets, private equity firms, export credit-agency supported debt finance, and financial support from manufacturers.

All borrowers like competition for their funding needs and diversification of the sources of funding. With the introduction of Basel III and the requirements it imposes on banks in relation to meeting capital, liquidity[41], and lending ratios, the cost of funding for banks has increased and banks' appetite for long-term lending has been reduced. This in turn has increased the cost of traditional loan finance for customers and made it more difficult for customers to raise loans with terms of 10 or more years from banks.

For these reasons, aircraft lessors are searching for sources of funding other than banks for at least part of their debt capital raising requirements. In the final analysis, aircraft lessors will choose between issuing corporate debt and using an SPV to securitise lease rentals and fleet assets depending on the relative cost of the two sources of finance as determined largely by the credit rating agencies. In addition, targeting the correct investor base, managing debt security marketing restrictions, and securitisation retention requirements will also play a major part in an aircraft lessor's debt financing strategy.

In recent times, we have seen some consolidation among aircraft lessors. The recent sale of Dublin-based SKY Aviation Leasing to Goshawk Aviation and Japan's Orix Corporation's USD2.2 billion purchase of a 30% stake in Avolon Holdings.

[40] Source: Citi Research. *Global Asset-Backed Securities Focus* dated 3 April 2018

[41] Liquidity ratio requirements require longer-dated, more expensive, funding to match longer maturities loans.

11.3.1 Analysing an Aviation Asset-Backed Security

Recital 90 of Commission Delegated Regulation (EU) 2015/35 of the European Parliament and of the Council (Solvency II) requires Insurance and reinsurance undertakings investing in securitisation to have a comprehensive and thorough understanding of the investment and its underlying exposures.

In order to achieve that understanding, insurance undertakings should make their investment decision only after thorough due diligence, from which they should obtain adequate information and knowledge about the securitisation.

The analysis of an aviation asset-backed security has six major areas of focus:

1. Purpose of the securitisation;
2. Structure of the SPV including the payments 'waterfall';
3. Assessment of the entity managing and operating the collateral pool;
4. Inherent business risks in the collateral and operation of the SPV;
5. Cash flow modelling; and
6. Conflicts of interest.

In all six major areas of focus, it is important to compare the features of the security with other securities already in issue. When such a comparison is conducted across a range of features it acts as an attention directing tool and highlights differences. A discussion of such differences improves the analysis. These six features will be key to determining the credit rating assigned to the Class A, Class B, and Class C debt securities issued by an SPV.

Purpose of the securitisation

It is important to understand the type of entity and its motivation for establishing the SPV.

The type of entity may indicate how it will behave in relation to the bondholders in the SPV. Where the entity is likely to have to use the aviation ABS market again and again, its behaviour in relation to the SPV bondholders is likely to be better than a private equity firm using the aviation ABS market to move aviation assets off its balance sheet or to finance a once-off investment in aviation assets.

Structure of the SPV including the payments 'waterfall'

Aviation ABS structures have a number of inherent weaknesses which if not mitigated leave investors in aviation ABS debt securities vulnerable to credit downgrades and losses.

First and foremost, the ability of the SPV to enforce its security interest in the underlying assets should be carefully examined from a legal and practical perspective as it may be limited in some respects.

Position in the Structure

The nominal value, LTV ratios, and credit enhancement of the issued debt securities of classes A, B, and C ought to be examined. Details of any cash sweep[42] associated with a class of debt securities including cash sweep percentages and start year are also important in assessing the value of a particular debt security. The minimum maintenance reserve and maintenance look forward period are also indicators of the level of protection offered to investors.

Portfolio Composition

The degree of credit risk in an aviation ABS depends in large part on the details of the underlying aircraft and the associated lease provisions.

The constituent assets of the portfolio in terms of aircraft and engines ought to be examined for diversification under the following headings:

- Number of Aircraft: Other features of the portfolio aside, the larger the number of aircraft in the portfolio the more diversification within the portfolio.
- Number of lessees: A larger number of lessees is preferable as the sources of cash flows are more diversified when there are more lessees. It's also important to look at the percentage of total cash flow accounted for by each of the top three lessees in the portfolio to better understand the diversification of the portfolio and assess their creditworthiness.
- Number of countries in which the lessees are located: Countries present jurisdictional issues in repossession and introduce currency risk particularly for regional airline operators. It's also important to look at the percentage of total cash flow accounted for by each of the top three countries of domicile or operation of lessees in the portfolio.
- Regions: Regions are usually broken down into developed and emerging to assess economic, currency, operational, and political risks. The location of airports used by lessees is important as this in part determines the operating environment for the aircraft engines. Maintenance reserve charges differ by region with lower charges applying in Northern Europe than in for example, the Middle East where there is likely to be a significantly greater ingestion of grit and sand or Russia with its extreme cold temperatures.
- Weighted average age of the pool of aircraft: Aircraft values decrease and become more difficult to assess with age. It's useful in this regard to examine a chart plotting the percentage of the value of the collateral pool against the ages of the aircraft in two-year bands.
- The distribution of the ages of the aircraft in the pool: This is useful in determining the likely spread of maintenance expenses over the life of security.
- Weighted average remaining lease term: Re-leasing an aircraft may pose a cash flow disruption hence the weighted average time to such potential risk is an important parameter of the collateral pool. It's useful in this regard to examine a bar chart

[42] Broadly speaking, in aviation ABS, cash sweeps usually require the borrower to use excess cash to periodically repay debt ahead of schedule. The starting date for a cash sweep to operate and the percentage of excess cash to be paid to lenders may vary as between Class A, Class B, and Class C debt securities.

plotting the percentage of the value of the collateral pool against the remaining lease terms in two-year bands.

- Variety of used aircraft split between narrowbody[43], widebody[44], regional jets, turboprops, and freighters: Aircraft values vary by type, potential use, and ease with which they can be re-leased. Pie charts of the variety of aircraft and original manufacturers are useful in assessing the collateral.

The extent to which the ABS structure provides for limits on the concentration of the collateral pool must also be examined. The concentration limits typically apply to re-leasing, aircraft sales, and permitted aircraft substitutions and vary by:

- The sovereign credit rating of countries or groups of countries;
- Regions usually split between developed and emerging markets;
- Type of aircraft;
- The split between aircraft that are no longer in production[45] and those that are in production;
- Any single lessee; and
- Three largest lessees.

The different types of concentration limits mentioned above may also vary with the level of the LTV ratio of the Class A and Class B debt securities.

Unusual Collateral

In some aviation ABS, investors may be surprised to find that the cash flows from aircraft that are not currently on lease may be included in the estimated cash flows of the SPV from some future date or dates. This unusual feature of aviation ABS may arise for several reasons and we provide two examples below.

Example 1

An aircraft which is not currently on lease to an airline may be included in the collateral pool backing the ABS and potential investors informed in the offering document for the aviation ABS that there is a letter of intent from an airline to lease the aircraft at some future date. Such letters of intent rarely specify the terms on which the aircraft will be leased yet the potential cash flows from the "letter of intent" lease may be included in the estimated cash flows accruing to the SPV.

Example 2

The potential cash flows from an aircraft which is on order from an aircraft manufacturer and for which no lease is currently negotiated for a date following the delivery of the aircraft may be included in the estimated cash flows accruing to the SPV starting on the expected delivery date of the aircraft.

[43] Generally, a single aisle commercial passenger aircraft. Relative to widebody aircraft, narrowbody aircraft tend to have a larger operator base, be easier to remarket, cheaper to reconfigure and transition from one lessee to another.

[44] Generally, a commercial passenger aircraft with two aisles.

[45] Out of production aircraft are generally speaking: (i) leased by airlines with relatively poor credit ratings; (ii) less fuel efficient; and (iii) more difficult to value and re-lease.

As part of the due diligence, an assessment would need to be made as to the likely success of the lessor-service-provider to the SPV in leasing such aircraft, the likely lease rates, the potential costs of storing the aircraft if they remain unleased, and the proportion of the total estimated cash flows coming from potential "letter of intent" and undelivered aircraft leases.

Cash Flows

The cash flows from the collateral pool of an SPV may be subject to disruptions due to such factors as:

(i) A longer than expected period of time required to re-lease an aircraft following the expiry of its lease;

(ii) An aircraft has to be repossessed, stored, and reconfigured because the lease payments have not been made; repossession may take time; following repossession a period of time may elapse before the aircraft can be re-leased to another airline; and the lease rental rate may be lower upon re-lease than that which was being billed prior to repossession;

(iii) Aircraft maintenance costs which have not been properly reserved for in the SPV structure; and

(iv) An aircraft is sold for substantially less than its expected sale value.

During the periods in (i) and (ii), there will be a loss of lease rental payments and maintenance reserve charges to the SPV and the SPV will incur storage costs which increase sharply with the passage of time. At short notice, aircraft storage can not only be difficult to obtain but also rather expensive.

Maintenance Reserves

The maintenance condition of an aircraft is a very important determinant of its value and the speed at which it can be leased.

Airlines with poor credit ratings are normally charged maintenance reserves on a monthly basis. The payment of maintenance reserves represents a charge for the utilisation of the engine, airframe, the limited life parts of the engine, the auxiliary power unit ("APU"), and the landing gear during the term of the lease.

Major maintenance work is carried out at discrete intervals of time such as every six years for a narrow-body aircraft. The fact that the maintenance event may not occur until after the end of the term of the lease, does not relieve a lessee from the requirement to pay for the utilisation of the aircraft which it consumed during the term of the lease. Maintenance reserves may be regarded as supplemental rent or regular payments into a sinking fund to pay for the major maintenance overhauls.

If an airline were permitted to make a lump sum payment for the maintenance of an aircraft at the end of the term of the lease, the SPV would have an increasing level of credit exposure to the airline as the term of the lease advances. Only airlines with the very best credit ratings are permitted to pay maintenance reserves at the end of a lease. Maintenance reserves are a large part of an SPV's cash flows.

Provisions for maintenance reserves ought to be close to the top of the waterfall of payments.

Letters of Credit versus Cash Maintenance Reserves

An airline may prefer to offer a letter of credit to a lessor rather than make regular maintenance reserve payments. With a letter of credit instead of cash maintenance reserves, the lessor loses the cash flow benefit of the maintenance reserves, loses interest on the deposit of maintenance reserves, is unable to recognise maintenance reserves as income for accounting purposes, and assumes bank credit risk for the maintenance reserves. Further, letters of credit need to be topped up periodically to reflect the accumulation of maintenance reserves over time.

Liquidity Reserve

To better secure the stream of cash flows promised to the different classes of bondholders in the SPV, a liquidity reserve may be established. In essence, this is a loan provided by a bank to the SPV. Certain conditions trigger the drawdown of the loan. The purpose of the loan is to smooth out cash flow disruptions by ensuring that certain expenses of the structure and interest on the Class A and Class B debt securities can be paid without interruption. A cash flow disruption may arise from the SPV having to repossess an aircraft thereby losing the rental income and the maintenance reserve payments while suffering the expense of repossessing, storing, reconfiguring, and remarketing the aircraft for a period that might be at least six months even for a very marketable aircraft. The loan must be repaid by the SPV to the bank from cash flows expected to arise in the future.

From the perspective of a potential bondholder, the higher the number of months' interest on the different classes of bonds that is covered by the liquidity reserve the better. Liquidity reserve might cover from four to nine months interest on Class A and Class B debt securities.

Once drawn down, the loan and interest on the loan are required to be prepaid by the SPV in line with the waterfall of payments. In addition to interest payments on the loan once it is drawn down, there is an annual fee of the order of 3% of the amount of the loan facility even if the loan is not drawn down.

There is usually a clause in the liquidity facility documentation requiring that if the credit rating of the bank providing the liquidity falls below a certain credit rating, the facility will be drawn down after a short cure period.

Flexibility Granted to the Service Provider in the SPV Documentation

In the early SPV structures, the power of the service provider to act in a crisis was limited. This led to delays in decision making which in many cases was to the detriment of bond holders. More recent SPV structures give the service provider more discretion.

Speed of Amortisation

For bondholders, the faster the amortisation of the loan the lower the risk in the structure. The amortisation schedule will depend on the WAL of the aircraft in the SPV and in part drives the credit rating of the tranche of the bond issued by the SPV.

For example, Class A[46] and Class B[47] bonds, issued by an aviation ABS backed by newer aircraft having say a WAL of say 3 years, the amortisation period might be of the order of 16 years[48]. By contrast, for the same classes of bonds issued by an aviation ABS with a WAL of 13 years, the amortisation period might be 12 years. In the latter case, the bonds with the lowest credit rating issued by the SPV, Class C bonds, would have a shorter amortisation period probably of the order of 6 years.

Leverage as Measured by Loan-to-Value ("LTV")

There are two measures of LTV in relation to the SPV of an aviation ABS:

1. Loan to maintenance-adjusted, appraised value; and
2. Loan to market value.

The maintenance-adjusted, appraised value of an aircraft is determined by specialist aircraft valuation firms based on the make, model, and maintenance status of the aircraft. The valuation is an entirely desk-based evaluation; the aircraft is not inspected by the valuation firm in determining its appraised value. The market value of an aircraft may differ from the maintenance-adjusted, appraised value.

The maintenance-adjusted, appraised value and the market value appraisal do not include the value of any payments due under any lease associated with an aircraft.

From the investor's perspective, the lower the LTV the better as there is less leverage in the structure and the bond holder rarely benefits from any upside in the structure.

Payments 'waterfall'

The payments 'waterfall' sets out the order in which cash flows will be applied; there are usually three kinds of payment waterfalls: (i) one that applies prior to an event of default; (ii) one that applies following an event of default; and (iii) one that applies in the event of a sale, part-out sale, transfer, receipt of insurance proceeds in connection with the total loss of an asset or other disposition of an asset in the collateral pool.

The order for applying cash flows in a payments waterfall prior to an event of default might be as follows[49]:

(i) Senior expenses and fees to service providers;
(ii) Interest on the Class A bonds;
(iii) Interest on the Class B bonds;
(iv) Pro rata, to replenish the liquidity facility reserve account and interest and principal repayments in relation to liquidity drawn down from the liquidity facility provider;
(v) The amount needed to replenish the maintenance support account;

[46] Class A aviation ABS would fall into the senior secured category of debt.
[47] Class B aviation ABS would fall into the subordinated secured category of debt as they usually rank behind Class A aviation ABS for coupon payments and repayment of capital.
[48] The useful economic life of a passenger aircraft is at most 25 years.
[49] This payments waterfall is adapted from the CLAS 2016-1 ABS securitisation.

(vi) First, **(a)** if neither a debt service coverage ratio[50] ("DSCR")[51] Event nor Accelerated Amortization Event[52] has occurred and is continuing but a Heavy Maintenance Reserve Event[53] has occurred and is continuing, the amount needed to replenish the Heavy Maintenance Reserve Account up to the Heavy Maintenance Trigger Amount; and **(b)** if a DSCR Event or an Accelerated Amortization Event has occurred in any of the three most recent payment dates, to replenish the Heavy Maintenance Reserve Account up to the Heavy Maintenance Required Amount;
(vii) Scheduled repayments of principal on the Class A bonds;
(viii) Scheduled repayments of principal on the Class B bonds;
(ix) If neither a DSCR Event nor Accelerated Amortization Event has occurred and is continuing, the lower of: (A) 75% of remaining available collections and (B) the amount needed to replenish the Heavy Maintenance Reserve Account up to the Heavy Maintenance Required Amount;
(x) To the Class A bonds, the lesser of: (a) the outstanding principal balance of the Class A bonds and (b) the excess proceeds series payment;

(xi) To the Class B bonds, the lesser of: (a) the outstanding principal balance of the Class B bonds and (b) the excess proceeds series payment;
(xii) If no Accelerated Amortization Event has occurred and is continuing, 50% of remaining available collections during year 6, 75% of remaining available collections during year 7, and 100% of remaining available collections in year 8 and thereafter of the transaction to: (a) first, the outstanding principal balance of the Class A bonds and (b) second, the outstanding principal balance of the Class B bonds;
(xiii) (a) If an Accelerated Amortization Event has occurred and is continuing, the outstanding principal balance of the Class A bonds and (b) if no Accelerated Amortization Event has occurred and is continuing but a Class A Note disposition shortfall has occurred (disposition proceeds less than the disposition pay down amount) the amount necessary to reduce such disposition shortfall to zero;
(xiv) (a) If an Accelerated Amortization Event has occurred and is continuing, the outstanding principal balance of the Class B bonds and (b) if no Accelerated Amortization Event has occurred and is continuing but a Class B Note disposition shortfall has occurred (disposition proceeds less than the disposition pay down amount) the amount necessary to reduce such disposition shortfall to zero;

[50] A DSCR Event is deemed to occur on any payment date on or after the X^{th} payment date on which the DSCR falls below 1.25x. On such payment date, all excess cash remaining after the distribution of all senior ranking payments will be deposited into the DSCR Event Account (unless an Accelerated Amortization Event has occurred and is continuing). This can be cured if the DSCR is at or above 1.25x for three consecutive payment dates.
[51] Broadly speaking, the DSCR can be computed by examining the cash flow available for debt service. The SPV will not be drawing down additional debt to repay other debt so the cash available for debt service will not exceed operating income. Likewise, the SPV will not be investing capital in aviation assets so the cash flow available for debt service will not be less than its operating income.
[52] If any of the following three events occur, the excess cash will be used to pay down the Class A Loans and then the Class B Loans, sequentially: (i) DSCR is less than 1.15x; (ii) The utilization rate of the portfolio is less than 75%; or (iii) The Y^{th} anniversary of the closing date for the securitisation shall have occurred.
[53] A "Heavy Maintenance Reserve Event" shall occur on any date if the balance of the Heavy Maintenance Reserve Account is less than the total amount of heavy maintenance expenses expected in the next three months.

(xv) If a DSCR Event has occurred in any of the three most recent payment dates, to the DSCR event account, all remaining amounts;

(xvi) Interest on the Class C bonds;
(xvii) Scheduled repayments of principal on the Class C bonds;
(xviii) To the Class C bonds, the lesser of (a) the outstanding principal balance of the Class C bonds and (b) the excess proceeds series payment;
(xix) 30% of remaining available collections during years X through X+3 and 100% of remaining available collections in year X+5 and thereafter of the transaction to the outstanding principal balance of the Class C bonds;
(xx) Subordinated expenses;

(xxi) Outstanding disposition premium first, to the Class A bonds and second, to the Class B bonds;
(xxii) From and after the Y^{th} anniversary of the closing date, step-up interest on the Class A bonds;
(xxiii) From and after the Y^{th} anniversary of the closing date, step-up interest on the Class B bonds;
(xxiv) From and after the Y^{th} anniversary of the closing date, step-up interest on the Class C bonds;
(xxv) Servicer incentive fee;

(xxvi) Amount needed to replenish the security deposit account;
(xxvii) Servicer extraordinary expenses amount;
(xxviii) Amount needed to fund the disposition contribution account, if applicable;
(xxix) Amount needed to fund the redemption reserve account, if applicable; and
(xxx) Remaining funds to the equity note account.

(xxxi) Remaining funds to the E Certificate account.

We do not discuss the payment waterfalls for the other two types of events.

Assessment of the entity managing and operating the collateral pool

The service provider to the SPV normally carries out the following functions as appropriate:

- Collection of aircraft lease rental payments and maintenance reserves from lessees;
- Marketing the lease of the aircraft and engines in the collateral pool;
- Selling the aircraft and the engines to generate cash flows for the SPV;
- Managing the maintenance and insurance of the aircraft and engines owned by the SPV; and
- Enforcing the rights of the SPV against lessees.

The assessment focuses on the experience of the management team both in the business of aviation leasing and credit risk management. In relation to the former, the management team must be composed of aviation leasing professionals with considerable experience in the industry and must be able to demonstrate a proven track record of intellectual capital to:

- Value older and specialised aircraft including commercial aircraft, business jets, air freight jets, and aircraft engines;

- Operate within the legal frameworks of many jurisdictions to monitor liens over leased aircraft and reprocess aircraft when lease payments are not made by an airline;
- Fully understand the dynamics of the market and know the airlines to which it might quickly re-lease an aircraft, the lease of which has expired due to it coming to the end of its term or due to repossession following an event of default under the lease. In this regard, knowing the number of operators of each family of aircraft worldwide and having a relationship with such operators is likely to be important.
- Insure and maintain aircraft and engines; and
- Keep track of where every aircraft and every aircraft engine[54] in the ABS structure is located and its maintenance status.

A due diligence team would wish to see strong policies and procedures in place in relation to all the above items as well as evidence of compliance with such policies and procedures.

A due diligence review of the management team would reasonably assess the team's credit risk management skills. Airlines defaulting on their lease commitments are by no means unusual.

Increasingly, aircraft are leased to airlines in the emerging market economies of Asia, a region which now accounts for over one third of global air traffic and which has been exhibiting the fastest rate of growth of "revenue passenger kilometres" ("RPK")[55]. Emerging markets tend to have lower per capital GDP and are more vulnerable to economic shocks than developed markets.

The due diligence team would likely wish to understand how the management team assesses the credit worthiness of potential lessees. The management team's credit evaluation of potential lessees ought to include country and jurisdictional risk analysis, the characteristics of the airline industry, an analysis of the financial statements of the potential lessee, the position of the potential lessee in the industry, discussions with the management of the potential lessee, and feedback from other lessors which may have dealt with the potential lessee.

[54] While lessors will wish to ensure they know the whereabouts of their aircraft and engine assets, lessees will want flexibility to swap engines and parts within their fleets. It is important to take local law advice in relation to such arrangements as, in some jurisdictions, moving an engine from one airframe to another may result in a transfer of title.

[55] The RPK of an airline is defined as sum over all flights operated by the airline in a period of the product of: (i) the number of fare-paying passengers carried; and (ii) the distance covered by the flight in kilometres.

The due diligence team would expect to find the standard protections for lessors in the lease agreement including security deposits, choice of civil aviation registration[56] venue, and structures in place to repossess the aircraft or engine such as an irrevocable de-registration and export request authorisation ("IDERA")[57] and a deregistration power of attorney in favour of the SPV. The deregistration power of attorney provides that, following an event of default under the lease, the SPV may proceed to deregister the aircraft and export the aircraft from the jurisdiction.

The aircraft leasing industry is one where lessors may wish to market an aircraft for lease to a lessee at some future date notwithstanding a lessee's default on an earlier lease. Further, repossession of an aircraft can be difficult and take considerable time in the absence of the cooperation of a defaulting lessee. It is therefore important to understand how the service provider balances cash collections, protecting the value of the aircraft or engine while maintaining a cooperative relationship with the defaulting lessee.

Fees

The lessor-service-provider will be paid a fee for its services. The fee is usually expressed as a percentage of cash flows received by the SPV as fees as a percentage of assets under management would require regular valuations of the aircraft which would be expensive and open to disagreements in relation to valuations.

Inherent business risks in the collateral and operation of the SPV

For aviation industry outsiders, it is difficult and expensive to value the collateral in an aviation ABS either initially or on an ongoing basis. Difficult because a valuation requires a knowledge of the supply and demand for different types of aircraft; and expensive because, while there are specialist valuation services available, the fixed charges for these services could not be justified by an investor with a relatively small exposure to aviation ABS.

Cash flow modelling

The purpose of the cash flow modelling is to assess the extent to which the cash flows under stressed conditions will support the payments due under the different classes of debt security. Aside from asset coverage, cash flow generation is the key investment issue in assessing an aviation ABS for investment.

[56] The Chicago Convention requires that every aircraft that is flying must have a state of registration.

[57] In the absence of the Cape Town Convention, the procedural law of the state of registration of an aircraft would apply to the deregistration and export of an aircraft. The Aircraft Protocol to the Cape Town Convention has a provision which establishes a clear set of rules that would not entail the exercise of discretion by the relevant civil aviation authority in connection with the deregistration and export of an aircraft. The lessee completes the IDERA in favour of a designated party giving the designated party and that party only the authority to seek the deregistration and export of the aircraft. The IDERA is then lodged with the relevant civil aviation authority in a contracting state of the Cape Town Convention that has decided to apply the IDERA. An IDERA cannot be revoked by the lessee without the consent of the authorised party. The relevant civil aviation authority is required to enforce the remedies under the IDERA without the need for a court order. The aircraft must be repossessed before the IDERA can be used as no sensible aviation authority would allow a lessor which does not have possession of an aircraft to deregister an aircraft.

The authors are not aware of a standard, sophisticated software package for modelling and stress testing the cash flows of an aviation SPV. A number of investment banks which underwrite aviation ABS use proprietary models to model and stress test cash flows. For many bond portfolio managers considering investing in aviation ABS, a considerable investment of resources would be required to model and stress test the cash flows of an aviation ABS.

The key variables in a cash flow model are lease rates, aircraft and engine values, lessee defaults, the costs of repossession, storage, remarketing, and reconfiguring aircraft following a lease termination, the loss of rent and maintenance reserves between the end of one lease and the beginning of the next lease of an aircraft, maintenance reserve revenues and maintenance expenses, and the useful economic life of an aircraft or engine.

Such models generate various scenarios for the cash flows under a lease based on assumptions regarding expected lease default rates and consider multiple exit options such as sell the aircraft, re-lease the aircraft to another airline, teardown the airframe or the engines and sell off the parts or sell the aircraft.

The cash flow analysis also tests the transaction structure under different stress events such as industry downturns. The number of industry downturns used in stressing the cash flows depends on the life of the transaction. It would not be unusual to allow for one industry downturn every eight years with each industry downturn assumed to last four years. During an industry downturn, it is possible that some of the assets will not be on lease and will be incurring higher costs or on-lease but at depressed lease rental rates.

The most important items in the cash flow analysis of an aviation ABS is to estimate the future aircraft and aircraft engine values and the lease rate factors applied to those values. These two factors vary by aircraft type and age and determine:

(i) Future cash flow streams from re-leasing an aircraft; and
(ii) The proceeds of aircraft disposals.

Ongoing Monitoring

For holders of significant amounts of aviation ABS, regular meetings with the service provider would be ideal in order to conduct ongoing due diligence. The Castlelake, CLAS 2018-1 transaction and the Air Lease Corporation, TBOLT 2018-1 transaction introduced a number of welcome ongoing disclosure improvements. For example, the CLAS 2018-1 transaction provides[58] for cash flow reporting, conference calls with investors where investors can pose questions and receive answers, and updates from the roll forward of the cash flow model. Combining this information with the state of the airline industry could then be used by investors to carry out further stress tests on the aviation ABS and decide whether it should be retained in the portfolio or sold.

[58]Source: Goldman Sachs & Co. LLC. Aviation ABS Market Update, October 2018.

Conflicts of interest

The service provider to an SPV is usually the lessor which moved the aircraft off its balance sheet and into the SPV. This may give rise to several different types of conflicts of interest between the following three parties:

1. The lessor which is also the service provider to the SPV;
2. The SPV bondholders; and
3. The holders of equity in the SPV.

The following are examples of some of the conflicts of interest that may arise:

- A conflict of interest would arise where the lessor-service-provider is trying to re-lease or sell an aircraft belonging to the SPV and at the same time trying to re-lease or sell an aircraft of the same type which is owned by lessor. There is a risk to the bondholders in the SPV that the lessor-service-provider might favour its own aircraft above those of the SPV in such a process.

- Similarly, where both the lessor-service-provider and the SPV lease at least one aircraft to an airline and the airline gets into financial difficulty, there is a risk that the lessor-service-provider may favour its own interests above those of the SPV in dealing with the airline.

- There may also be one or more directors in common with the lessor-service-provider and the SPV.

Newer aviation ABS attempt to address some of the conflicts of interest that arise between bondholders and a lessor-service-provider by, for example, establishing an incentive fee structure for the lessor-service-provider payments under which payments are tied to achieving certain aircraft sales and aircraft re-leasing targets. Another technique used to address conflicts of interest is to have a majority of independent directors on the board of the SPV and require a unanimous vote for all board decisions.

In terms of conflict of interest risk management, a lessor-service-provider with a public listing will be required to make robust public disclosures and may be preferred to a private lessor-service-provider.

11.4 Unsecured Debt – General Credit Risk Assessment

11.4.1 Unsecured Airline Debt

When conducting due diligence on unsecured, passenger-airline debt issues, the risk characteristics of the industry outlined earlier in the paper ought to be considered along with the country risk and the position and profitability of the issuing passenger-airline in the industry.

In the past, air travel has exhibited growth cycles which generally come to an end every eight years or so. Continuing low inflation and relatively low interest rates in rich-world economies coupled with good global GDP growth has sustained the current cycle somewhat beyond its

cyclical eight-year limit. Given the globally diverse nature of the supply chain for the building of aircraft, perhaps the biggest current risk faced by the industry is the risk of a global trade war which would almost certainly hinder the supply of and demand for aircraft.

Between 2001 and 2011, in the U.S., the default rate among airlines was been extremely high, with almost every major airline including U.S. Airways, United Airlines, Northwest Airlines, Delta Airlines, and American Airlines filing for bankruptcy. More recently, according to the Financial Times[59], in 2017, Monarch in the UK, Air Berlin, and Alitalia[60] went bankrupt in quick succession and, in 2018, the following European airlines went out of business: Latvia-based Primera Air, Cobalt Air of Cyprus, Germany's Azurair, Lituania's Small Planet Airlines, and Swiss SkyWork.

[59] Source: ft.com. *European aviation: winter blues blow airlines off course European aviation: winter blues blow airlines off course* https://www.ft.com/content/744976f4-fb0a-11e8-aebf-99e208d3e521

[60] Alitalia is still flying with the backing of the Italian government while potentially awaiting a new owner.

12 Appendix 3

12.1 Capital requirement $SCR_{securitisation}$ for spread risk on securitisation positions

Securitisation means a transaction or scheme, whereby the credit risk associated with an exposure or pool of exposures is tranched, having both of the following characteristics:

(a) payments in the transaction or scheme are dependent upon the performance of the exposure or pool of exposures;

(b) the subordination of tranches determines the distribution of losses during the ongoing life of the transaction or scheme.

Let's illustrate the computation of the capital requirement $SCR_{securitisation}$ for spread risk on securitisation positions by reference to an actual securitisation by Castlelake known as the Castlelake Aircraft Securitization 2016-1 or CLAS 2016-1 securitisation.

The CLAS 2016-1 securitisation came to the market near the end of July 2016 with three tranches, Class A, Class B, and Class C having respectively coupons of 4.45%, 6.15%, and 8.00%. The rising level of coupon from Class A through Class B to Class C, reflects an increasing level of risk and this is borne out by the initial credit ratings for the classes which were respectively A, BBB, and BB.

Table 9 below summarises some of the key points of the CLAS 2016-1 securitisation.

Table 9
CLAS 2016-1 Securitisation

Class	Nominal Value (USD millions)	Loan-to-value (per cent)	Credit Enhancement (per cent)	Coupon (per cent)	Rating (KBRA[61])
A	715	64	36	4.45	A (sf)
B	130	76	24	6.15	BBB (sf)
C	71	82	18	8.00	BB (sf)

Sources: Citi Research Securitized Products 3 April 2018 and KBRA.

The CLAS 2016-1 Securitisation would not meet the requirements of Article 177(2)(h)[62] and therefore would not qualify as a Type 1 securitisation position as the securitisation is **NOT** backed by a pool of homogeneous underlying exposures, which all belong to only one of the following categories:

1. Different types of residential loans;
2. Commercial loans, leases and credit facilities to undertakings to finance capital expenditures or business operations other than the acquisition or development of commercial real estate, ***provided*** that at least 80 % of the borrowers in the pool in terms of portfolio balance are small and medium-sized enterprises at the time of issuance of the securitisation, and none of the

[61] KBRA appends an (sf) indicator to ratings assigned to structured finance obligations.

[62] COMMISSION DELEGATED REGULATION (EU) 2015/35 of 10 October 2014 supplementing Directive 2009/138/EC on the taking-up and pursuit of the business of Insurance and Reinsurance (Solvency II).

borrowers is an institution as defined in Article 4(1)(3) of Regulation (EU) No 575/2013;

3. Auto loans and leases for the financing of motor vehicles or trailers, agricultural or forestry tractors, motorcycles or motor tricycles or tracked vehicles.

We conclude that an aircraft securitisation will not meet the requirements of a Type 1 securitisation position because of the nature of the collateral.

Under Solvency II, Type 2 securitisation positions include all securitisation positions that do not qualify as Type 1 securitisation positions.

The capital requirement for spread risk on Type 2 securitisation positions is equal to the loss in the basic own funds that would result from an instantaneous relative decrease of $stress_i$ in the value of each Type 2 securitisation position i.

The risk factor, $stress_i$, shall be equal to the following $stress_i = \min(b_i * dur_i; 1)$
where:
(a) dur_i denotes the modified duration of securitisation position with i denominated in years;
(b) b_i is assigned depending on the credit quality step of securitisation position i according to Table 10 below.

Table 10
Mapping Credit Quality Steps to b_i

Credit quality step	0	1	2	3	4	5	6
Long-term issuer credit rating scale	AAA	AA	A	BBB	BB	B	CCC, CC, C, D
b_i	12.5%	13.4%	16.6%	19.7%	82%	100%	100%

Source: COMMISSION IMPLEMENTING REGULATION (EU) 2016/1800 of 11 October 2016

Using the mapping in Table 10 and the data for the CLAS 2016-1 securitisation in Table 9, we can calculate the SCR for holdings of the three classes of securities in this securitisation. The SCR capital must be financed. We also calculate the cost of financing the $SCR_{securitisation}$ capital requirement at a rate of 6% per annum noting that all other things being equal, this cost would fall as the modified duration of the three classes of security decreases. Table 11 below contains the computations, the SCR figures, and the cost of financing the SCR.

Table 11

Class	Rating (KBRA[63])	Credit quality step	b_i (per unit of duration)	Modified Duration (as at 3 September 2018[64])	SCR before diversification	Cost of financing SCR at 6% p.a.
					Percentage of Value of Security	
A	A (sf)	2	16.6%	2.17	36.02%	2.16%
B	BBB (sf)	3	19.7%	2.16	42.55%	2.55%
C	BB (sf)	4	82.0%	1.02	83.64%	5.02%

[63] KBRA appends an (sf) indicator to ratings assigned to structured finance obligations.
[64] Source: Bloomberg.

Table 12 illustrates the reduction in capital charges that would apply to the Class A and Class B debt securities issued under the CLAS 2016-1 securitisation if it were classified as a Type 1 securitisation. The Class C debt securities issued under the securitisation are rated BB (sf) which maps to credit quality step 4. To qualify as a Type 1 securitisation, a debt security must have a credit quality step of 3 or lower. Hence, the Class C debt securities of the securitisation do not appear in Table 12.

Table 12

Class	Rating (KBRA[65])	Credit quality step	b_i (per unit of duration) Type 1	Modified Duration (as at 3 September 2018[66])	SCR before diversification	Cost of financing SCR at 6% p.a.
					Percentage of Value of Security	
A	A (sf)	2	3%	2.17	6.51%	0.39%
B	BBB (sf)	3	3%	2.16	6.48%	0.39%
C	NOT APPLICABLE					

Table 13 illustrates the combinations of credit quality step and modified duration that will cause the insurance undertaking's capital requirement for securitisations to be 100% of the value of the position.

Table 13

Credit Quality Step	0	1	2	3	4	5 or more
b_i	12.5%	13.4%	16.6%	19.7%	82%	100%
Modified Duration	8.000	7.4627	6.0241	5.0761	1.2195	ANY
SCR before diversification	100%	100%	100%	100%	100%	100%

Any securitisation with a modified duration of more than 8 years commands a capital requirement of 100% of the value of the securitisation position.

[65] KBRA appends an (sf) indicator to ratings assigned to structured finance obligations.
[66] Source: Bloomberg.

13 Appendix 4

13.1 Risks Relating to Aviation ABS Debt Securities

Conventional debt securities provide for a fixed rate of interest to be paid until their maturity and upon maturity, the repayment of the entire principal. By contrast, aviation ABS debt securities provide for payments of interest and partial repayments of capital throughout their life.

Owners of aviation ABS debt securities run the risk of having to reinvest the pre-payment of principal at lower yields. Thus, when compared with conventional, fixed-income, debt securities of the same legal maturity, aviation ABS debt securities may have:

- Less potential for capital appreciation during periods of falling interest rates;
- A similar propensity to suffer falls in value during periods of rising interest rates; and
- A higher degree of credit, liquidity, and valuation risk.

14 Appendix 5

14.1 Currency Risk Management

Most EETC securities and aviation ABS debt securities are denominated in USD. For a Eurozone domiciled and EU regulated insurance undertaking, the USD denomination of such securities poses a currency risk in addition to the other risks of debt securities which include the risk of changes in USD interest rates and of changes in credit spreads of such USD dominated debt securities.

14.1.1 Unhedged Currency USD Exposure

Table 14 below illustrates the possible outcomes for a Eurozone domiciled and regulated insurance undertaking which does not hedge the EUR/USD currency exposure associated with USD-denominated, aviation, debt securities.

Table 14

	USD denominated aviation debt securities Rise in Value	USD denominated aviation debt securities Fall in Value
EUR strengthens against USD	Gain on USD denominated aviation debt securities diminished by loss on FX exposure	Negative returns on FX exposure and on USD denominated aviation debt securities
EUR weakens against USD	Positive returns from both the FX exposure and the USD denominated aviation debt securities	Loss on USD denominated aviation debt securities dampened by gain on FX exposure

The return in EUR terms of an unhedged portfolio of USD-denominated aviation debt securities is given by the following formula:

$$(1 + R_{ABS})*(1+e_{EUR/USD}) - 1 = R_{ABS} + e_{EUR/USD} + R_{ABS}*e_{EUR/USD}$$

where R_{ABS} is the return in per cent on the portfolio of aviation debt securities in USD terms and $e_{EUR/USD}$ is the return in per cent on the EUR/USD exchange rate movement.

The variance of a foreign currency denominated portfolio of aviation debt securities which is unhedged is approximately the sum of the three terms:

(i) The variance of the aviation debt securities in the foreign currency;
(ii) The variance of the currency exchange rate; and
(iii) Twice the covariance of (i) and (ii).

We use the word approximately above because we ignore the variance of the cross-product term involving the return on the portfolio of aviation debt securities in foreign currency terms and the return on the currency as this is typically an order of magnitude smaller than that of the variance of ABS debt securities or currency returns.

14.1.2 "Fully" Hedged USD Exposure

We place the word "fully" in italics as no hedge is perfect. In practice, the transaction costs of fully hedging a foreign currency asset even one with the liquidity of the USD against the EUR would be prohibitively expensive. A "fully" hedged position would be required if the Eurozone domiciled and EU regulated insurance undertaking were using USD-denominated aviation debt securities in a portfolio of assets to match say a portfolio of EUR-denominated annuity liabilities in circumstances where it was applying to its EU regulator for a *matching adjustment*[67] under Solvency II.

Investors assuming long-term currency risk in their portfolios must believe: (i) that the currency exposure will reduce the overall risk of the portfolio because of low correlation between the currency and the portfolio; or (ii) that by assuming currency risk, not insignificant additional returns will accrue to the portfolio.

By contrast with the unhedged case, the variance of a currency hedged portfolio of USD denominated aviation debt securities has only one significant component: the variance of the aviation debt securities in the foreign currency.

The return, in EUR terms, of a fully hedged portfolio of USD-denominated aviation debt securities is given by the following formula:

$$(1 + R_{ABS})*(1+e_{EUR/USD}) + (f_{EUR/USD} - e_{EUR/USD}) - 1$$
$$= R_{ABS} + e_{EUR/USD} + R_{ABS}*e_{EUR/USD} + (f_{EUR/USD} - e_{EUR/USD})$$

where R_{ABS} is the return in per cent on the portfolio of aviation debt securities in USD terms, $e_{EUR/USD}$ is the return in per cent on the EUR/USD exchange rate movement, and $f_{EUR/USD}$ is the forward premium[68] in per cent.

We ignore the variance of: (i) the carry, $(f_{EUR/USD} - e_{EUR/USD})$; and (ii) the cross-product term, $R_{ABS}*e_{EUR/USD}$, involving the return on the aviation ABS debt securities portfolio in foreign currency terms and the return on the currency. The variance of these items is typically an order of magnitude smaller than that of the variance of aviation debt securities, R_{ABS} or currency returns, $e_{EUR/USD}$.

[67] The EU Solvency II framework requires insurers to value their liabilities using a risk-free interest rate derived from the liquid part of the market swap rates curve. For liabilities extending beyond the liquid part of the curve, the risk-free rate is extrapolated to a long-term equilibrium rate specified under the Solvency II framework. Buy-and-hold investors hold securities to maturity and therefore can capture a liquidity premium while limiting their risk exposures to downgrade and default risk. When an insurance undertaking sets aside a portfolio of assets to back a predictable portion of its liabilities, the *matching adjustment* allows the insurance undertaking to use a higher rate of interest rate to value its liabilities. The higher rate of interest is determined from the yield spread over the risk-free rate credit spread of the portfolio of matching assets, less a fundamental spread that reflects expected default and downgrade risk. In order to use a matching adjustment, an insurance undertaking must obtain approval from the regulator in its home EU Member State.

[68] The forward premium in per cent is the forward rate at the time of effecting the hedge divided by the spot rate at that time less 1. The result is expressed as a percentage.

We can see from this analysis that unless the covariance term is sufficiently negative to cancel out the variance of the currency exchange rate, the foreign currency exposure will increase the variance of the foreign currency denominated aviation debt securities portfolio.

Investors who believe that they have no skill in the forecasting of currency exchange rates view currency hedging as eliminating a risk for which there is likely to be no expected long-term return.

The currency hedge is likely to be executed using forward foreign exchange contracts which are rolled, typically monthly, with the result that gains or losses on the hedge are realised and reflected in the net asset value of the relevant account of the insurance undertaking. In essence, the particular account of the insurance undertaking bears all the expenses and gains or losses resulting from the EUR/USD hedging transactions.

In looking at a currency hedging operation, it would be important to understand whether the bank executing the hedge: (i) extends a line of credit to the fund so that gains or losses on the hedge are settled at the end of the month or quarter as the case may be; or (ii) requires some initial margin and further daily margining as the hedge is marked to market.

Currency hedging requires either the reinvestment of gains on the currency hedge or the funding of losses on the currency hedge. In terms of risk management, it is important to focus more on how losses on currency hedges are funded than on how gains on currency hedges are reinvested. Procedures must be established by the investment management division of the insurance undertaking for funding FX hedging losses arising. For example, such losses may be funded firstly from cash holdings and then by selling the securities in which the investment management division has a 'low conviction' rating.

The investment division of the insurance undertaking need to have robust systems in place to monitor execution prices for foreign exchange transactions to ensure that it is getting competitive FX execution.

Ideally, the investment management division ought to have at least one foreign exchange prime broker in whose name the investment management division can execute foreign exchange trades among a number of competing foreign exchange traders. Trades executed by the investment management division at the competing foreign exchange traders are then 'given up' to the prime broker which in turn will allocate them to the relevant account of the insurance undertaking.

Most of the major international banks offer electronic foreign exchange trading platforms which can be used by an investment management firm under a prime brokerage arrangement. In addition, there are electronic systems available which ensure execution of foreign exchange trades at the most competitive rate among several competing foreign exchange platforms offered by global investment banks.

Using Currency Swaps to "Fully" Hedge USD Exposure

While at first glance a currency swap may allow a Eurozone domiciled and EU regulated insurance undertaking to fix the cash flows from a USD denominated, aviation debt security,

we do not consider the use of currency swaps for the purpose of "fully" hedging USD denominated aviation debt securities in this paper for two main reasons:

(i) Currency swaps are priced to include a spread over the interest rate differential between the two currencies. When the currency swap is initiated, this spread is fixed for the life of the currency swap. However, the size of the prevailing spread in the market for a new currency swap varies over time and this affects the valuation of the currency swap during its life. This variation in the market spread creates volatility in the valuation of a currency swap. Further, an additional cost will arise for the Eurozone domiciled and EU regulated insurance undertaking if it happens to be paying the spread as opposed to receiving the spread.

(ii) If the USD denominated aviation debt security defaults, the insurance undertaking is left with the independently executed currency swap. At the time of default, the independently executed currency swap will have either a positive or negative mark-to-market value.

15 Appendix 6

15.1 Special Purpose Vehicle

Lending directly to a borrower or an entity in the same group as the borrower runs the risk that the lender's security may be subject to potential claims from the borrower's creditors in the event of insolvency of the borrower.

An SPV is generally a newly formed company established for a defined purpose; it has no previous trading history, no debts, and no liabilities. In lending to airlines and aircraft lessors, an SPV allows for the de-coupling of a pool of assets which secure a loan from the credit risk of a lessee airline which operates the aircraft or the lessor which borrows the money. The SPV's pool of assets is not available for distribution upon the bankruptcy of the lessee or lessor. Financiers prefer to take SPV credit risk rather than the credit risk of the lessee or lessor as doing so improves the predictability of the outcome for the lender in the event of the insolvency of the lessee or lessor.

SPVs have no creditors other than the lenders who financed the purchase of the pool of aircraft assets. By lending to an SPV which owns an aircraft, the lenders have the comfort that there could be no competing claims that could attach a claim to the aircraft or other assets owned by the SPV.

SPVs are used for security and enforcement reasons. A lender is in a much better position to repossess its collateral, the aircraft, upon default of a lessee airline or a lessor if the SPV is the owner of the aircraft than if it is a mortgagee. Ownership is a universally recognised right in legal jurisdictions across the globe. By contrast, a lender as mortgagee seeking to repossess its aircraft in the jurisdiction of the aircraft will have to produce its English law or New York law security document to a foreign court which will then have to consider the effects of the security document under its own laws. This legal process may take a considerable length of time and the outcome is less certain. Further, the insolvency laws in the jurisdiction of the airline may be less favourable and less responsive than say New York as a jurisdiction.

If the SPV is a subsidiary of the lessee/lessor, there is a risk of consolidation upon the insolvency of the lessee/lessor; for this reason, lenders prefer orphan[69] SPVs. In Ireland, orphan SPVs would normally have their shares held on trust by a share trustee such as a corporate service provider that is an independent third party, for the benefit of a charity. Thus, the SPV is not beneficially owned by anyone connected with the transaction. The insolvency of one of the parties to the transaction will not affect the solvency of the orphan SPV. The assets and liabilities of an orphan SPV are not included on the balance sheet of any of the parities to the transaction. This ensures that in the event of insolvency of any of the parties to the transaction, the assets of the SPV should not be accessible to any party other than the lender.

[69]Lenders will only lend to a weak credit via an orphan SPV. ECAs insist on lending only to orphan SPVs. Strong credits dislike an orphan SPV loan structure because of the loss of capital allowances and the cost of the structure.

An SPV is usually required to covenant among other things that it will not: (i) issue new shares; (ii) engage in any other business; (iii) change its constitutional documents; (iv) create any liens over the assets of the SPV; and (v) prejudice the assets or the collateral of the SPV.

SPV structures may also be structured in such a manner as to mitigate withholding taxes on: (i) lease rental payments; (ii) loan interest payments; and (iii) deposit payments.

Lenders to an SPV limit their recourse to: (i) the assets of the SPV; and (ii) the lease rental payments due to the SPV; except in circumstances such as failure to hand up lease payments to the lenders, material misrepresentation, breach of SPV covenants, fraudulent behaviour or wilful misconduct.

15.2 Securitisation

In the context of aviation finance, a securitisation is a transaction that enables an aviation lessor to refinance a set of assets, e.g. aircraft and aircraft engines and the cash flows arising from the leasing of such assets, by converting them into securities issued by an SPV that investors can purchase. The aircraft lessor transfers a portfolio of aircraft and aircraft engines and the associated lease receivables into an SPV which issues sets of subordinated securities which determine the distribution of losses during the ongoing life of the transaction or scheme targeted at investors with different risk and reward appetites. The cash-flows generated by the underlying aircraft and aircraft engines including cash flows arising from the sale of such assets are used to repay the purchasers of the securities.

Interestingly, only a very small number of debt securities arising from securitisations by aircraft lessors have a rating in excess of A. The average age of the aircraft, the number of lessees, the geographical split of lessees between emerging and developed markets, the type of aircraft, narrowbody or widebody, and the track record of the asset servicer's management team are among the factors that determine the credit rating of debt securities issued by the SPV.

16 Appendix 7

16.1 Solvency II Capital Requirements Reduce Returns for Insurance Undertakings

We provide a simple illustration of the impact on the internal rate of return ("IIR") available on a debt security of having to hold regulatory capital in respect of the debt security.

The IRR assumes that each payment under the debt security can be reinvested at the IRR which is unlikely to be the case in practice.

To illustrate the impact on the IIR, we defined several variables:

ti, time in years to the i^{th} payment under the debt security.

N(ti), the nominal amount outstanding at time ti; for i=0 and i=1 we assume that N(t_0) and N(t1) are assumed to be equal and that N(tf) is assumed to the nominal amount repaid at maturity of the debt security.

C(ti), the coupon rate applicable to N(ti).

r, the continuously compounded annualised IIR

SII(ti), the Solvency II capital required at time ti

P, the dirty price paid for the debt security.

We ignore the impact of any time delay between purchase date and settlement date on the IIR in this simplified analysis.

We first calculate the IIR on the debt security ignoring the impact of any requirement to hold regulatory capital. This IIR is found by solving the following equation for r:

$$\mathrm{P} = \sum_{i=1}^{f} [N(ti) * C(ti) + \big(N\big(t(i-1)\big) - N(ti)\big)\big] * e^{-r*ti} + N(tf) * e^{-r*tf}$$

If we define $\big([N\big(t(i-1)\big) - N(ti)\big)\big]$ to be ΔN(ti), the equation simplifies to:

$$\mathrm{P} = \sum_{t=1}^{f} [N(ti) * C(ti) + \Delta\mathrm{N(ti)}\,] * e^{-r*ti} + N(tf) * e^{-r*tf}$$

This is the IIR that a private investor might earn as he or she has no requirement to set aside capital in order to hold the investment.

An insurance undertaking investing in a debt security is required to set aside regulatory capital which will gradually be released over the holding period of the debt security. Initially, the purchase price much therefore be increased by SII(t0) and as the risk of the security from a regulatory capital perspective falls, the regulatory capital is released over the holding period with each coupon payment and finally the reminder of the regulatory capital is released with the payment of the final maturity payment under the debt security.

If we define $([SII(t(i-1)) - SII(ti)]$ to be ΔSII(ti), the IIR allowing for the Solvency II regulatory capital can be found by solving the following equation for k:

$$\mathrm{P} + \mathrm{SII(t0)} = \sum_{ti=1}^{f} [N(ti) * C(ti) + \Delta\mathrm{N(ti)} + \Delta\mathrm{SII(ti)}] * e^{-k*ti} + (N(tf) + SII(tf)) * e^{-k*tf}$$

Bearing in mind that

$$\mathrm{SII(t0)} = \sum_{ti=1}^{f} [\Delta\mathrm{SII(ti)}\ ] \quad + SII(tf)$$

and that for any positive value of k, $SII(\mathrm{t0}) > \sum_{i=0}^{f} [\Delta\mathrm{SII(ti)}] * e^{-k*ti} + SII(tf) * e^{-k*tf}$ the effect of the requirement to hold solvency capital is to reduce the IIR for the insurance undertaking.