Securitisation Working Party

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Including Insurance Indices and the boundaries between Banking and Insurance

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INTRODUCTION

1 Background

1.1 In 1997, a paper on Securitisation was produced for GISG, which provided a background to Insurance securitisation, covering the history, the development, and the reasons for the growth of this new area for the insurance industry.

1.2 This year's paper began as two separate working parties: one looking at Insurance Indices and the other looking at the convergence of the Insurance and Banking industries. Due to the inevitable overlap, the two working parties were combined into a single paper, although

1.3 This paper is split into three sections. The first section covers insurance indices. Futures and options are traded upon a range of commodities and also a range of indices. To be able to create and trade insurance derivatives, a number of insurance indices have recently been developed, and have been used in a number of recent deals between the insurance industry and the capital markets.

1.4 The second section covers catastrophe exchanges. This includes a brief summary of the current and proposed catastrophe exchanges, and a discussion on the fall of catastrophe futures and the rise in catastrophe options. It also illustrates a worked example of how the derivatives trade on one of these exchanges may be used to replicate a traditional reinsurance contract.

1.5 The third section addresses the convergence between the insurance and banking industries.

1.6 We recommend that newcomers to this area of the insurance industry refer to last year's GISG paper to understand the background to and reasons for insurance securitisation.

2 Introduction

Insurance Indices

2.1 Futures and options are traded on a range of commodities and indices. To create and trade derivatives based upon insurance risk, there needs to be a reliable, consistent and unbiased measure of the "price" of insurance.

2.2 There have been a number of insurance indices around for many years, covering measures such as the premium rate, the underwriting result and the amount of catastrophe loss.

2.3 However, these indices do not necessarily have all the desirable features required for an index upon which to base a tradeable financial instrument.

2.4 Over the past two years, a number of insurance indices have been developed (in the US) that attempt to address some of the problems that were encountered when trying to base financial transactions upon the existing indices.

2.5 In this paper, we look at the development of insurance indices, the uses for them, the desirable features and discuss the potential for a UK insurance index.

2.6 The table below summarises the completed securitisation deals to date. These deals are discussed further in the Appendices (and the Appendix to the 1997 Working Party Paper). The table also shows the reference index used in each deal.

COMPLETED SECURITSATION DEALS					
Insurer	**Date**	**Risk Capital**	**Description**	**Index?**	**Risks covered**
Hannover Re	1995	$85m	Notes/preference shares	No	Multi-continental cat risk
AIG (PX Re)	May 1996	$10m	Zero coupon note	SIGMA	Multi-continental cat risk
Hannover Re	Nov 1996	$100m	Portfolio linked swap	No	Range of classes/territories
St Paul Re	Dec 1996	$45m	FRN/Preferred equity	No	Range of classes/ territories
Winterthur	Feb 1997	$7m	Convertible subtnd. bond	No	Swiss auto hail
Reliance National	Mar 1997	$10m	FRN at discount	SIGMA	Range of classes/territories
USAA	Jun 1997	$400m	Notes	Index trigger	East Coast-hurricane
Unknown Reinsurer	1997	$35m	Swap	USAA Deal	East-coast hurricane
Swiss Re	Aug 1997	$113m	Notes	PCS	Californian Earthquake
Tokio Marine	Oct 1997	$90m	Notes	JMA	Tokyo earthquake
Florida JUA	Feb 1998	$75m	Notes	No	Florida Windstorm
Mitsui Marine & Fire	April 1998	$30m	Swap	JMA	Tokyo Earthquake
Reliance National	April 1998	$10m	FRN at discount	SIGMA	Range of classes/territories
Reliance National	May 1998	$25m	Option to issue FRN	SIGMA	Range of classes/ territories
USAA	June 1998	$450m	Notes	Index trigger	East Coast-hurricane
Yasuda	June	$80m	Notes	No	Japanese Typhoon

	1998				
Client of Paribas	July 1998	$30m	Option	No	California earthquake
F&G Re	July 1998	$50m	Notes	N/K	Catastrophe reinsurance

Banking and Insurance

2.7 Historically, banks and insurers have held very different positions in the financial services marketplace. Different regulatory controls and legislation have kept insurers and banks as separate financial services providers.

2.8 However, recent changes in regulation and legislation have torn down this historical boundary, and forced both industries to re-evaluate their positions.

2.9 This is clearly illustrated by the recent merger in the US between Citicorp and Travellers to create one of the world's largest financial services organisations.

2.10 We believe that this cross-over/merging/convergence of the insurance and capital markets will be an ever increasingly important area for both the insurance industry and for the actuarial profession.

2.11 In this paper, we look at some of the issues facing the two industries as they attempt to understand how each other is analysing and managing what can sometimes be exactly the same problem.

INDICES

3 General Discussion of Indices

3.1 Before considering insurance indices it is useful to consider the use of indices in other areas, such as the forecasting of the general state of the economy.

3.2 A variety of formal economic measures are used – balance of payments surplus/deficit statistics, Gross National and Domestic product, money supply indicators, unemployment statistics.

3.3 Many of these indices have suffered from either significant reporting delays (so they merely tell economists or other users what they already know) or major inaccuracies (so that they turn out in retrospect to have presented a misleading picture) or both. In addition there have been disputes about what the indices actually represent (e.g. unemployment statistics).

3.4 Many of these measures have been restated and re-estimated or their use (e.g. in setting monetary policy) discontinued. Analysts and forecasters have been led to seek alternative, often "cruder" measures as predictors of the current situation.

3.5 Examples of such cruder predictor indices actually used are:

- CBI quarterly business confidence indicator
- The Economist "R-Word" index which counts the number of times "recession" is mentioned in the daily press

3.6 Other measures that have been suggested are:

- Amount of free office space available for rent in London
- Rush-hour traffic flow through the Dartford Tunnel

3.7 Moving to insurance indices, LIRMA and Lloyd's already publish surveys of underwriters' views on whether rates and terms are improving or worsening, and we invite the reader to consider some other insurance equivalents of the "cruder" measures above, for example:

- The occupancy of the LUC or Lloyd's building
- The number of brokers/underwriters entering and leaving the Lloyd's building per day

- The number of times the phrases “over-capacity” or “softening” are mentioned in the insurance press – the “S-Word” index

4 Insurance indices

4.1 We shall consider an insurance index as an attempt to represent in numerical form some aspect of the insurance market.

4.2 Indices may capture information on loss amounts or on premium rates or on both.

4.3 Loss indices could represent

- Estimated total economic losses or just insured losses
- Losses over a set period or from a specified event
- Losses from a defined area or defined peril or defined class of insurance (or some combination of the three)

4.4 Premium indices may look at one risk, or a basket of risks or may be more general indicators of the movement in rating levels in a market (e.g. based on a survey).

4.5 Premium and loss indices can be combined into loss ratio indices or profitability indices.

5 Uses of indices

5.1 Before discussing the properties required by an index it is helpful to consider the uses to which they may be put:

- As the basis for insurance-based derivative contracts – such as insurance options, catastrophe futures or premium futures. These may be for over the counter deals or more commonly standardised, exchange traded products where some form of index is essential for secondary trading and hedging (see below)

- In insurance bonds – either to define the loss event or to act as an independent trigger (see below)

- As a trigger in other insurance contracts or insurance based transactions – e.g. double trigger covers based on a investment and insurance trigger

- Benchmarking – allowing companies themselves as well as analysts, rating agencies, and regulators to assess a company's performance against the market

- To give a guide to a particular feature of the insurance market at a point in time: E.g. premium indices are commonly quoted to assess the position of the market cycle; industry loss estimates are used as an early warning system by bodies such as regulators and reinsurers to assess the potential impact of a major loss event and by smaller insurers to estimate their own losses (based on their market share)

6 Uses of indices in Securitisation - Advantages

6.1 Use of an indexed loss definition in an insurance bond rather than the insured's actual losses (a so-called indemnity based transaction) has a number of advantages for the investor, including

- Reducing the apparent asymmetry of information between investor and insurer and in particular making it possible to invest in insurance without detailed knowledge of one insurer's particular book of business
- Removing the risk of moral hazard, that the insured can manipulate the reported losses to their benefit
- Facilitating assessment of the risk compared to other insurance bonds or to insurance derivatives
- Possibly making administration (e.g. loss assessment) quicker and easier – by facilitating the fast exchange of information based on transfer of index values from an independent third-party body rather than the transfer of loss information from insured to investor
- Making it possible to invest in insurance without being exposed to the poor underwriting or administration of one insurer

6.2 These factors should mean that indexed-based bonds are more competitively priced by investors than indemnity-based bonds (but see below).

6.3 In addition to the reasons above, the use of an index for insurance derivatives ensures that risks are standardised and is essential if derivatives are to be traded and exchanged in a liquid market.

6.4 The compilation of insurance indices has therefore been essential for providing a viable market in catastrophe based options. This has:

- Allowed the insurance industry to hedge (albeit imperfectly) insurance risks by methods which are potentially more efficient than traditional reinsurance
- Provided alternative sources of capacity for transferring catastrophic risks.
- The need for such alternative capacity has become more important with demographic changes which have resulted in a redistribution of the population to, and an accumulation of high-

value properties in, catastrophe prone areas such as Texas, Florida and California

- Allowed institutional and private investors the opportunity to participate directly in insurance risk – thus providing a source of diversification to their existing portfolios

- Allowed investors to buy insurance as an investment decision without having any insurable interest.

- [It is interesting to note that it was the use of insurance as a form of investment (or more accurately gambling) by, for example, buying life insurance on the life of a defendant in a murder trial, that led to the early Insurance Acts requiring purchasers of insurance to have a pecuniary interest.]

6.5 In addition, for the insured, use of indexed-based protection:

- means that they do not have to disclose what may be commercially sensitive information on their exposure levels or losses

- gives them the ability to hedge market results and to lever their own underwriting expertise.- e.g. by hedging against high market loss levels or low market premium rates

7 Uses of indices in Securitisation - Disadvantages

7.1 The significant disadvantage of an indexed-based protection for the insurer is basis risk

7.2 Basis risk in this context is the risk that the losses covered by the index on which the bond or derivative is based do not exactly match the actual losses suffered by the insurer and for which they are seeking protection.

7.3 Hence either they can end up with insufficient recoveries when they are most needed or they may be paying for reinsurance protection that is not required.

7.4 The presence of this basis risk reduces the price which insurers are prepared to pay for reinsurance protection purchased by way of insurance bonds or derivatives and so offsets the fact that investors may be willing to offer such protection at more keenly-priced terms (see above).

7.5 There can be difficulties if the index used suffers from delays in compilation.

7.6 In practice these two requirements – for manageable basis risk and timely reporting are often in conflict (see below).

7.7 Finally, there may be regulatory (e.g. tax or solvency) problems with accounting for the protection offered by an index-based bond or derivative as reinsurance – as the insured may not be deemed to have any insurable interest.

8 Difficulties with compiling an insurance index

8.1 In order to compile an index it is necessary to have reliable, generally accessible information, but this has historically proved difficult for insurance indices, for a number of reasons:

- For premium based indices there is in many markets (particularly commercial insurance) no obvious standard risk or basket of risks to use as a base for comparing prices. Instead every risk is unique.

  Further there is no agreement on how to allow for changes in terms (deductibles, aggregates and less numerically expressible features such as clauses) which are often more important than the change in rate or premium.

- For loss based indices, there is no agreed centralised database of insured losses. Further, for catastrophe losses, which are often of the greatest interest for insurance derivatives and bonds, there is very limited historical information on past losses due to their historical rarity of such losses.

- Insurance contract terms, insured risks, potential exposures and losses incurred are all considered confidential or commercially sensitive information which only exacerbates these problems.

- Even if the data itself can be submitted and recorded in some form that maintains this confidentiality, it is held by existing market players who may be extremely reluctant to release this information to non-industry players.

- For example – insurers with large market shares may be unwilling to release information to compile premium or profitability based indices as this may help new players (e.g. bancassurers) to enter the market.

- As another example, some major reinsurers may be unwilling to release information which may facilitate the growth in securitisation as a source of competing capital.

- Further, even if insurers are theoretically willing to release information, they may be unwilling to incur the practical work involved. For example an event-based loss index may involve the rapid compiling of information in a standardised form from a range of insurers whose first priorities after a major event will be to assess and deal with their own losses and reinsurance

recoveries and to compile their own internal management statistics.

9 Desirable properties of insurance indices

9.1 The exact properties needed by an insurance index and the importance of each will depend on the use to which it is to be put, but the following list contains a number of desirable features of an index to make its use as wide as possible:

Objectivity

9.1.1 The method of compilation of the index should be transparent and easy to understand. The index should be free from the possibility of manipulation by those reporting data and with no perceived asymmetry of information between insurance industry insiders and outsiders. These qualities are particularly important for indices that are to be used in trading by non-industry participants.

Basis-risk

9.1.2 The index should facilitate the management of basis risk. This will depend on the level of detail to which the index is reported, the transparency and documentation of the calculation method, the credibility of the calculation method and on the presence of any past history of index values (see below)

Timeliness

9.1.3 The index should be reported regularly and in a timely fashion. The speed of compilation is particularly important for an index that is to be used for active trading and as a predictor of market losses.

Understandability

9.1.4 There should be a verifiable audit trail for data collection and submission. In addition, there should be an easy to understand and well documented method for index calculation and compilation.

Credibility

9.1.5 The index should prove reliable at calculating loss amounts or premium movements. This is particularly important for any index that reports quickly based on estimates or modelling, although for indices based on compiling loss estimates it is important that the sampling error is minimal. In addition, the index values should be reproducible so that the same inputs give the same outputs. Users must have confidence in the veracity of the underlying data

Robustness

9.1.6 The results of the index calculation should not be overly sensitive to small changes in the underlying data or its compilation.

Past history

9.1.7 The index should have a recorded past history – allowing assessment of the past behaviour and predictive performance of the index. This can also be important to allow management of basis risk.

Respectability

9.1.8 It is useful if the index is compiled (or at least backed) by a respected, independent body.

9.1.9 We suggest that one such body that is particularly appropriate for insurance indices is the Institute and Faculty of Actuaries – given the bodies involvement in high-profile investment indices and the professions expertise in the area of insurance.

Consistency

9.1.10 It is important that the compilation of the index is consistent between periods and that the methodology or data inputs are not altered over time.

9.2 There is often a fundamental conflict between some of these properties – in particular between those for timeliness and credibility.

9.3 As an example, loss based indices which are based on simple loss surveys and/or loss modelling are capable of being produced in hours after a major loss has occurred (often before many companies know their own losses). However such indices are open to the possibility of giving potentially misleading estimates of ultimate losses.

9.4 By contrast, accuracy can be achieved by basing an index on collection of detailed loss information from a very wide range of insurers using accurate methodology and comprehensive data collection. However, such indices are often calculated "after-the-event" once ultimate losses are known – and hence are little use for predictive purposes or for active trading.

9.5 This trade-off can be seen in the insurance indices that are already in use.

10 Existing insurance loss indices

10.1 In this section we consider a number of insurance loss indices which are already in active use. We outline the way in which they are compiled and assess them against the criteria we have set out above.

ISO Index

10.2 This index is described briefly for historical interest as it was the original index used as the basis of trading of insurance-derivatives on the Chicago Board of Trade exchange, from the inception of trading in December 1992 to September 1995 (when it was replaced by the PCS index).

10.3 It was based on a loss survey of property-casualty insurers carried out by the Insurance Services Office, who picked a representative sample of 26 of the 100 or so insurers that report losses to it.

10.4 Losses were those caused by wind, hail, earthquake, riot or flood and were recorded nationally and for three regions (Eastern, Midwestern and Western), on a quarterly basis.

10.5 The index was a loss ratio index – of losses to premiums (which were estimated from the property premiums in the statutory returns of contributing insurers).

PCS Index

10.6 In September 1995, the CBOT exchange changed to insurance options based on an index compiled by the Property Claims Service Index. This index was also used in the Swiss Re securitisation of Californian Earthquake risk and was to be used in the proposed ACE securitisation.

10.7 PCS is a non-profit organisation, which, since 1949, has had the responsibility in the US for defining a catastrophic event, assigning it a serial number and calculating aggregate insured losses from it.

10.8 The CBOT insurance options track 9 PCS catastrophe loss indices – National, five regions (Eastern, North-eastern, South-eastern, Midwestern and Western) and three catastrophe-exposed states (Florida, Texas and California).

10.9 PCS estimates total insured personal and commercial property line losses from catastrophic events (as defined and listed by PCS) for each of these regions on a quarterly basis (annually for California and Western) using a combination of three methods:

- A survey of insurance companies, agents and loss-adjusters, representing around 70% of the market
- By modelling losses, using its own National Insurance Risk Profile which has been developed from census data, tax records, demographic data and inventories of buildings and vehicles at risk code level
- In some cases, by their own on-the-ground surveys of a sample of insured buildings

10.10 PCS provides estimates of losses from a major event within three to five days of it occurring. These estimates are then revised over time – with the actual CBOT options having a six or twelve month development period after the quarter end before they are closed.

10.11 The actual PCS index is a loss index and is normalised by dividing loss estimates in the given area and quarter by $100M.

10.12 More recently CBOT has commenced trading on options based on loses from a defined event, rather than aggregate losses.

10.13 The rapid reporting time of the PCS losses makes them very useful as a first-estimate of industry losses and for insurers to estimate their own losses. It also means that the CBOT options are very useful for short-term trading.

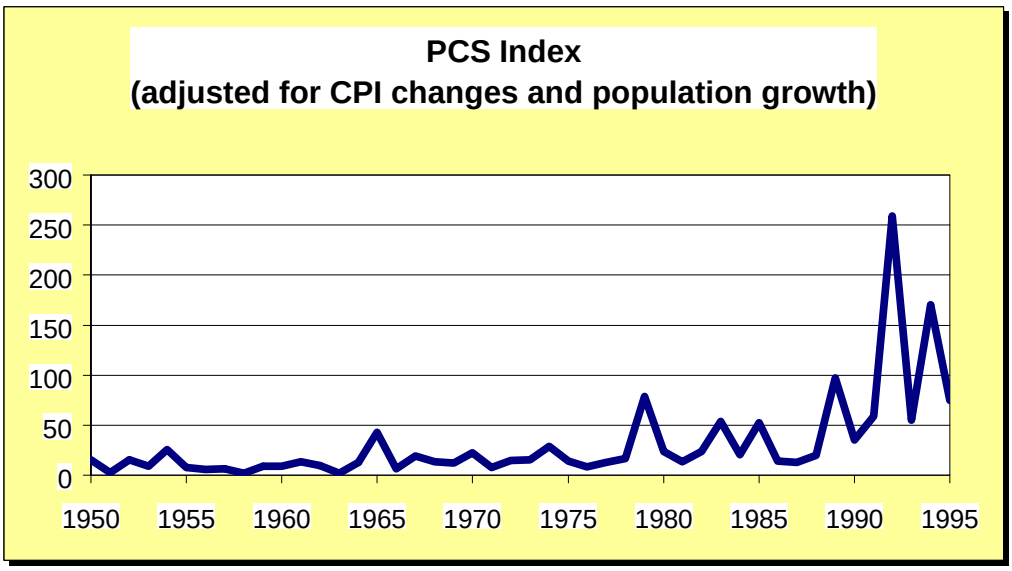
10.14 The index has a wider range of geographical coverage and a larger and more representative sample of contributing insurers than the ISO index and has therefore proved much more successful for trading on CBOT as basis risk is easier to manage.

10.15 However, compared to other indices (e.g. the GCCI index) – the PCS index is less amenable to the management of basis risk. The loss experience of an individual insurer is unlikely to be easily derived from aggregate regional or state-wide estimates, particularly as they are not even broken-down by peril or class of business (within the wide-ranging property class).

10.16 Further, the methodology used by PCS is not at all transparent or easily understood – e.g. the relative weight given to estimates from

the three sources, the way in which estimates are compiled from survey data – and the indices have been heavily criticised for these reasons.

10.17 The graph below shows the development of the PCS index from 1950:



Sigma Index

10.18 This is not a formal Index as such but a listing of major losses. Since 1970 the Sigma publication (produced by Swiss Re) has been providing tables listing major world-wide losses on an annual basis. These loss estimates feature all major insurance losses with the exclusion of third-party liability claims.

10.19 There are two major loss categories," Natural catastrophes" and "Man-made catastrophes".

10.20 The term natural catastrophes is taken to mean an event caused by natural forces. The study divides natural catastrophes into 6 categories: Flood; Storm; Earthquake (including seaquake and tsunami); Drought, bush fire; Cold, frost and Other (including Hail and avalanche).

10.21 The report regards "man-made" or "technical" catastrophes to be those major events that are connected with human activity. The study divides man-made disasters into 7 categories: Major fires/explosions; Aviation disasters; Shipping disasters; Road/rail disasters; Mining disasters; Collapse of buildings/bridges and Miscellaneous.

10.22 The sources of information for the choice of events are daily newspapers, direct insurance and reinsurance periodicals, specialist publications as well as reports from direct and reinsurance companies. Since it is impossible to include all occurrences, the Sigma Study does not claim to be comprehensive.

10.23 In order to maintain consistency in the criteria used for compilation, the minimum limit for damages is adjusted annually to compensate for inflation.

10.24 The latest Sigma Study reveals that in 1997, total losses from the 348 events recorded amounted to $ 28.8 billion and claimed more than 22,000 lives. Insured losses comprised $ 6.7 billion. Adjusted to allow for inflation, this is around 50% less than the previous year, which in turn was around 25% lower than 1995. This was primarily because no extremely costly catastrophes occurred over the year.

10.25 The index would not appear to have been designed as a formal way of calculating insured losses to be used in financial instruments, but rather as a broad-based indication of aggregate losses. For this reason no particular attempt has been made to make its methodology objective or transparent, to ensure the timeliness of its publication or to facilitate the management of basis

risk, so that the indices fail if measured against many of our criteria above.

10.26 Notwithstanding these facts, indices based on compiling subsets of the losses in the annual SIGMA loss reports (e.g.: losses from individual territorial areas such as Europe; losses from individual risk classes such as satellite losses) were used as the basis of the AIG Combined Risk and Reliance National Securitisation issues. They have also been used in a number of finite risk and over-the-counter transactions.

10.27 The reason for this apparent contradiction may be that the indices are very wide ranging, compiling losses from a wide variety of areas and loss types, whereas the other indices in this section are comparatively narrowly based.

RMS Index

10.28 This index has been launched in the last year by Risk Management Solutions – a catastrophe modelling company whose models were used for the recent Yasuda deal.

10.29 The RMS index does not use reported losses, or loss surveys but instead uses exposure measures by geographical location (at zip code level) and computer-based modelling of events to produce damage estimates for hurricanes and earthquakes.

10.30 The principle behind such indices is very simple. The use of catastrophe models to calculate company losses from a simulated storm is now commonplace in the insurance and reinsurance industry. This type of index is calculated by running such a model on industry exposure data and on parameters describing an actual event that has just occurred.

10.31 In this case, RMS's IRAS (Insurance and Investment Risk Assessment System) is used. When an event occurs, a database of exposed properties is input to the IRAs technology, together with technical parameters describing the event. In the case of hurricanes, the input parameters are location, direction, velocity, central pressure and radius to maximum wind speed.

10.32 Individual event losses are then calculated from the model and normalised by dividing by $100M and rounding to the nearest integer. An aggregate index value is then calculated by summing losses across all qualifying events and again dividing by $100M before rounding.

10.33 Although the RMS methodology is subject to continual modification and improvement, the model, exposure data and methodology for any one index series will be fixed, to ensure consistency.

10.34 The index is initially focused on US insurance industry losses, although other areas to be included are the UK, Japan, and some countries in Continental Europe.

10.35 Loss estimates are provided within one week of an event so that the index is suitable for short-term trading and for early loss estimation.

10.36 Loss estimates are provided at zip code level and by peril and class of business, so that the management of basis risk is, in theory, facilitated. In addition, the use of an independent model is intended to make the index objective and free from the possibility of manipulation.

10.37 However, catastrophe models have, in general, not always proved to be very reliable estimators of losses, particularly as it is very difficult to fully capture an event by a few parameters.

10.38 By relying exclusively on such estimates, without including any measure of actual losses incurred, this index is open to the possibility of significant divergence between modelled and actual losses, which will frustrate any attempt at basis risk management.

10.39 The test of this will only come in the actual future performance of the model (catastrophe models can always be calibrated to perform well in "estimating" major past losses) but this very uncertainty about its credibility is a disadvantage of this index.

GCCI Index

10.40 The Guy Carpenter Catastrophe Index has been compiled by IndexCo, an affiliate of the broker Guy Carpenter since 1997 and underlies the catastrophe option contracts traded on the Bermuda Commodities Exchange.

10.41 The index accesses a huge database containing details of paid losses and insured values provided by over thirty of the largest insurers in the US. Using this information, IndexCo calculates loss to value ratios for events and time periods for almost ten thousand zip codes. These can be aggregated using pre-defined weights to generate index values for states, regions or nationally (Texas has a different methodology).

10.42 The traded options are based on national losses, 4 regions (North-east, South-east, Gulf and Midwest) and two states (Florida and Texas).

10.43 Loss estimates are based only on direct multi-peril policies on owner occupied dwellings in the US caused by hurricane, tornado, windstorm, hail or freezing temperatures. There are a range of policy exclusions (e.g. mobile homes, policies with windstorm exclusions, home business cover) and of peril exclusions (e.g. fire, flood, lightning, earthquake, riot).

10.44 Losses and insured values at risk are reported in great detail – losses by zip code level, peril, construction and age of building, and insured values at risk by construction, age and premium written. This together with the use of a loss to value ratio (rather than an aggregate loss value) means that an insurer can easily apply the reported indices to its own exposures to estimate its own losses.

10.45 In addition the use of predefined weightings makes basis-risk with the traded index very easy to manage, particularly as IndexCo publish extensive literature on the methodology behind the index thus ensuring a very high degree of transparency.

10.46 Objectivity is improved by calculating the loss to value index as a weighted average of the loss to value figures for the contributing insurers, so that it is not unduly weighted towards the larger contributors.

10.47 However, due to the huge amounts of data required to be collected, verified and processed, the index can only be produced quarterly and suffers from timeliness problems – so that it is not very useful for short-term trading or as a first estimate of losses.

10.48 In addition, due to the index definition and exclusions it only covers around 2/3rds of insured losses in the US and this has been criticised as restricting the use of the index. For example the index does not measure earthquake losses – exposure to which has been behind much of the activity in insurance securitisation.

10.49 Finally, the use of a limited sample of insurers and of a value-risk index mean that in some ways the index resembles the ISO index whose use at CBOT led to only very limited trading (see above).

10.50 The following table summarises the four current indices (excluding ISO) and is an expanded version of the table produced by Bruce Thomas in his paper “Homogenising Catastrophe Risk: An Overview of Catastrophe Indices”.

	PCS	SIGMA	RMS	GCCI
Use	Basis for catastrophe options traded on CBOT	Provides information on insured losses from natural and man-made catastrophes world-wide	Basis for issuers of and investors in catastrophe risk securities	Basis for catastrophe options traded on BCX
Geographic Detail	State (CBOT options based on PCS loss index for 9 US areas)	Country	ZIP code	ZIP code (BCX traded indices on 7 areas)
Insured Property	All major lines (Commercial and Personal)	All lines	All major lines	Homeowners
Perils	All significant perils	All perils	Earthquakes and hurricanes	Hurricanes, hailstorms, tornadoes, thunderstorms, winter storms and freezing conditions
Index Value	$ of loss	$ of loss	$ of loss	Paid loss to insured value ratio
Methodology/ Data Sources	Insurer survey, risk profile information, computer model, survey of damage	News and other sources	Computer loss models	Based on experience of over 30 companies insurance and paid loss records in over 10,000 geographic areas
Other Information Provided	None	Number of casualties	None	Premiums, deductibles, amounts of insurance, claim counts, paid losses, construction types
Objectivity	Methodology not fully transparent or easy to understand due to subjectivity in estimation	Reliant on judgement in processing information from different sources; methodology not transparent	Fixed methodology for each series, however model requires subjective input; Low risk of moral hazard	Published transparent methodology; unweighted averages of insurers' loss-to-value ratios; Low risk of moral hazard
Managing basis risk	Below State level, basis risk is not readily measurable	Geographic detail insufficient for effective management	High level of detail (by ZIP code and line of business), but accuracy may be questionable	Good information base for measurement and management (individual area reporting, use of loss-to-value ratios)
Timeliness	Early publication; produced 3 to 5 days after event with updates as necessary	Published annually; Too late for trading purposes	Early publication; produced within 7 days after event; Final value after 28 days	Delayed publication; produced quarterly
Future Developments	Possible development of event-based indices		Indices based on events outside the USA e.g. earthquakes in Japan	Data requirements may be too great to extend to other event types

11 UK – Existing Measures

11.1 There are a number of existing insurance indices in the UK, although none are used for insurance related financial products.

Premium Indices

The AA Private Car Index

11.2 This is a simple monthly index of the premium rates charged for a standard sample of 50 customer profiles.

The SBC Warburg Dillon Read Motor Premium Index

11.3 This is a unweighted measure of the "average premium rises" of the major market players (but generally excluding direct companies such as Direct Line). As this is unweighted and does not reflect actual rates charged to customers it should not be relied on to accurately track market rates.

SURL's Lloyd's Rating Index

11.4 An annual index based on a broad survey of market rates, split into Marine, Non-marine and Aviation.

CBSL Lloyd's Market Rate Index

11.5 Similar in concept to the SURL index.

LIRMA indices

11.6 LIRMA were reported in the financial press as considering the establishment of an exchange of indices based on premium rates in a number of London market classes (e.g. motor fleet, UK professional indemnity, airline risks). These indices were to be calculated by asking a select number of insurers or brokers to quote for standardised risks.

11.7 The exchange was to concentrate on risks that were reasonably homogeneous and where there were sufficiently sophisticated buyers of insurance so as to make a natural market with both players who wanted to hedge the risk of rates decreasing and players who wanted to hedge the risk of rates increasing.

SURL Lloyd's Underwriting Index

11.8 This index attempts to show the trend in underwriting profit potential in each of the main Lloyd's market sectors. It is a refinement of the rating Index (see above) in that changes in policy conditions, claims inflation and the costs of reinsurance are also factored into the index.

AXA – Comprehensive Motor cover premium index

11.9 AXA have in July 1998, launched a series of European motor insurance indices (see below). One of these indices is a premium index for the cost of comprehensive car insurance – reported on a country basis.

Profitability indices

Sedgwick Global Underwriting Index

11.10 This index measures the Global Lloyd's result at the close of each underwriting year (including the effect of Reinsurance to Close from previous years and the transfer of RITC to the next underwriting year).

11.11 This index has been calculated historically for 50 years. Interestingly the best year was 1994 and the worse year in history 1989.

Claims indices

Axa European Motor Indices

11.12 The indices launched in July 1998 (see above), included a European average and by country quarterly indices of Private car Insurance claim frequency and total claim costs.

11.13 The source of the data for these indices is the Comite Europeen des Assurances, who in turn receive the data from each country's insurance association (e.g. the ABI in the UK).

11.14 For the UK, claims costs are incurred costs (i.e. change in claim incurred plus claims paid) during the period. Hence costs are smoothed over reporting periods (by the release or build-up of margins in reserves) rather than accurately tracking accident periods.

11.15 The degree of consistency between countries is not clear.

Instrat Index

11.16 This index was launched by Sedgwick in 1993 (and backdated to 1981). The index recorded the incidence of gross property damage claims experienced in the UK by the (pre-merger) 8 largest composite insurers as measured by their DTI returns.

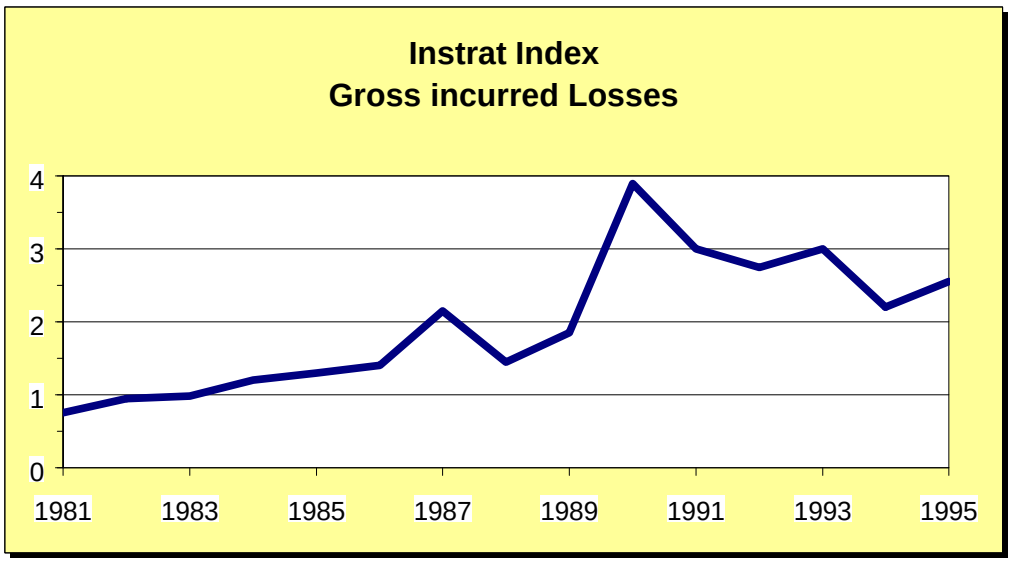
11.17 The index was projected forwards to give likely future mean values with confidence levels calculated from the variability of historic data.

11.18 The index was used to illustrate how a UK claims index might work and as a basis for illustrating the way in which such an index could be used as a basis for futures and options contracts.

11.19 The index had the advantage of transparency, robustness and ease of construction but as a practical tool suffered from the fact that it could only be calculated on an annual basis, eight months after the end of the year.

11.20 Due to the change in the format of the statutory returns (with UK losses no longer being reported separately) the index will not be reported for 1997, as it cannot be calculated from public information.

11.21 The following graph shows the development of the Instrat Claims Index, including the calculations backdated to 1981.



12 UK – Availability of data

12.1 Because of a reluctance to surrender a competitive advantage by ceding information to new players in the insurance industry (see above) UK insurers (especially the larger insurers) are generally unwilling to put information into the public domain.

12.2 This is evidenced by such examples as

- the reduction in membership of the Motor Risks Statistics Scheme to only the smaller insurers
- the winding up of the ABI Liability Survey following the withdrawal from the survey of the larger liability insurers

12.3 The main sources of published claims data available at the moment are:

- DTI returns
- Available annually, at least 6 months in arrears
- Fire Prevention Association
- The Fire Prevention Council's journal "Fire Prevention", published 10 times a year, contains statistics tables detailing fire losses (as supplied by insurers) where the estimated cost exceeds £250,000 for:

  - individual claims for months in isolation, 1-2 months in arrears

  - number of cases notified and total estimated loss of fires listed by cause and type of building for 12 months after the end of the rolling 12 month period

- ABI Quarterly General Business Statistics

  Gross incurred claims are supplied for the major perils of Theft, Fire, Weather Damage (split by commercial and domestic business). Domestic Subsidence and Business Interruption.

  The incurred claims are on a revenue basis and so will not accurately reflect losses from an accident period.

  These are produced one quarter in arrears. ABI members and many non-ABI insurers contribute (but Lloyd's losses are excluded).

- ABI Quarterly Motor Returns

  The ABI collects quarterly gross incurred claims, claim numbers and policy exposure figures from most UK insurers. Again these figures are often supplied on a revenue or notification basis.

13 UK – Outlook for producing an insurance index

13.1 The absence of an independent index provider and the lack of sufficient data from across the industry seem to be the main reasons why no UK Insurance Index has been established to date.

13.2 The decline in co-operation within the industry in supplying data to central surveys reflects the increasing competitiveness of the sector.

13.3 It is likely that the production of an index of sufficient quality to satisfy the required properties outlined above would ultimately have to be paid for by the industry. This currently appears unlikely as most UK insurers do not see the need for UK insurance derivatives in view of the relatively low catastrophe exposure and the over-supply of conventional reinsurance capacity.

13.4 The major insurers do not appear interested in using an index for benchmarking purposes either. At present they seem content to be compared against their quoted competitors on the basis of quarterly or half-yearly "bottom-line" results, rather than benchmarking their performance in each line of business against the sector as a whole.

13.5 However, despite the pessimism in these comments, we do believe that there exists sufficient storm-related data currently collected by the ABI to allow a credible UK index to be constructed. Likewise the Fire Protection Agency's journal contains sufficient information from which to build a "large fire index".

13.6 It is also our belief that the Institute and Faculty of Actuaries is an ideally placed independent body to oversee the compilation of such an index.

14 Other indices

14.1 The discussion in this section has concentrated on premium and loss indices but there are a variety of other indices that could be useful in measuring insurance risk:

Parameteric Indices

14.2 These are indices that measure the size or magnitude of natural phenomena that often lead to major insurance losses, e.g. earthquake or wind indices. The Tokio & Matsui Marine deal used an earthquake index to define payments whereas the two USAA deals have relied on a parametric trigger (a hurricane index) as a trigger for potential recoveries (with losses being taken as USAA's own insured losses, provided the index had exceeded the trigger point)

Economic indices

14.3 Unemployment and house price indices should provide a good proxy for the risk under a range of insurance business – e.g. credit business, creditor, mortgage indemnity, surveyors' and solicitors' professional indemnity cover

Stock exchange indices

14.4 The new FTSE/Bermuda Stock Exchange Bermuda Insurance Index (which is a market capitalisation weighted index of the stock prices of 11 quoted Bermudan insurers) and should be heavily correlated both with rating levels and world-wide insurance (particularly catastrophic) losses

Lloyd's capacity prices

14.5 Lloyd's auctions or bilateral deals represent the trading of insurance risk and so an index of the prices paid could illustrate the value of insurance business. As an aside, it could be argued that for hundreds of years before the supposedly cutting-edge development of securitisation and insurance derivatives, Lloyd's has provided a route by which individual investors could invest in pure insurance risk.

EXCHANGES

15 Catastrophe Exchanges

15.1 There are currently four specifically insurance related exchanges. Three of these are devoted to catastrophe property risks only. The remaining one trades an index of Bermuda domiciled insurance stocks within the Bermuda stock exchange.

15.2 The three exchanges for property catastrophe risks are the Chicago Board of Trade (CBOT), Bermuda Catastrophe Exchange (BCE) and the Catastrophe Risk Exchange (CATEX). These three exchanges trade very similar but not identical products.

15.3 At the CBOT, options are traded for various territories on *aggregate* losses as reported by Property Claims Services (PCS). At the BCE options are traded on *single event* and *aggregate* catastrophic losses as measured by the Guy Carpenter Catastrophe Index (GCCI). Clearly, large single events affect aggregate losses, so losses on these two risks are correlated. CBOT has plans to trade single events.

Chicago Board of Trade (CBOT)

15.4 Property Claim Services (PCS) is a division of American Insurance Services Group Inc, a non-profit organisation. PCS estimates US insured property damage for catastrophes in the Catastrophe Serial Numbering system (running since 1949), which includes all catastrophes above $5m insured loss.

15.5 PCS loss estimates cover net insured losses only, on property and boats, but exclude aircraft and uninsured property losses. Estimates are produced for dollar loss and number of claims. PCS applies a range of methods but chiefly a confidential survey of insurers. They also use census and economic data. For large (over $250m) and special (e.g. earthquakes) events PCS issues a series of estimates, updating every 60 days until the figure is stable. Options on these indices are traded on the CBOT.

15.6 The 9 PCS Indices are:

- National
- Regional (Eastern, Northeastern, Southeastern, Midwestern, Western)
- State (Florida, Texas, California)

15.7 Each index covers a specified Loss Period – usually a quarter, but a year for California and Western indices – and continues to be adjusted during a six-month or twelve-month Development Period (the user chooses which). Contracts are Small Cap (losses limited to $20 billion) and Large Cap ($20-50 billion).

15.8 The index points represent $100 million, and the tick is 0.1 point – i.e. prices are quoted to the nearest $5 million. One contract is $200 per point. (In the next section we show an example of how an insurer might use the index to replicate a traditional reinsurance layer.)

15.9 The margin call (performance bond margin) is the cashflow required by the exchange to ensure security and liquidity. The performance bond margin system at CBOT is SPAN (Standard Portfolio Analysis of Risk, a registered Trademark of the Chicago Mercantile Exchange). SPAN uses simulation to calculate a "worst reasonable" one-day net loss for each participant and this is the minimum margin.

15.10 Prices are quoted as follows:

- Strike Price – the index value for exercising the option
- Bid
- Offer
- Open Interest – how many options are outstanding. As of April 1998 there were approximately 22,000 contracts with open interests.

Bermuda Commodities Exchange (BCOE)

15.11 The Bermuda Commodities Exchange was formed to provide a new insurance derivative contract based on an index of catastrophic losses in the US and commenced trading in November 1997. The index is based on US property losses using methodology developed by Guy Carpenter. The launch of BCE followed efforts by the Bermuda Stock Exchange to launch CATEX (Bermuda).

15.12 There are three products: initially an Aggregate contract and a First Event contract and later a Second Event contract. Each contract is a franchise contract (i.e., paying out in full once the trigger is hit, rather than proportionate to the size of the loss). Contracts are margined on full exposure, whereas at the CBOT the theoretical minimum margin is 20% of exposure. The contract size is $5,000

and fees are per contract. As of April 1998 6 contracts had been consummated at BCE.

Catastrophe Risk Exchange (CATEX)

15.13 The Catastrophe Risk Exchange (CATEX) provides a means whereby primary insurers and reinsurers against property loss can have access to a wider distribution of their risks, as well as a wider diversification of the perils they insure against. CATEX was formed as a New York company in April 1995, and licensed as the world's first neutral reinsurance intermediary three months later. It was set up, not as a risk bearing entity, but to facilitate the exchange of catastrophe risks among insurers and reinsurers. It started trading operations in October 1996.

15.14 CATEX operates as a computer-based trading exchange, with access to the trading system limited to CATEX subscribers. Industry loss ratios, for particular books of business, will be used initially to assist traders in comparing risks and assigning values to potential transactions – though ultimately the prices are determined by the transacting parties.

15.15 CATEX is a notice board where a larger variety of insurance risks and contracts can be advertised than in the other two exchanges. As at April 1998, many of the listings have involved catastrophic risk for the same territories as the CBOT and BCE. The prices in these listings should be in line with the prices of the exchanges; otherwise arbitrage will be possible.

Catastrophe Exchanges			
	Chicago Board of Trade	**Bermuda Commodities Exchange**	**CATEX**
Forum	Open Out-cry	Electronic	Electronic notice board
Clearing	"AAA" Clearing Corporation	Clearing House	None.
Product	PCS Options	BCE Options	Various
Geographic Regions	United States	United States	World wide
Geographic Detail	State, Region, Nation	Zip code	Per contract
Insured Property	Commercial, Private	Homeowner	Per contract
Perils	All Perils	Atmospheric perils	Per contract
Index	PCS	GCCI	Per contract
Index Value	$100 million of loss	Varies by contract	Variable
Index Source	Insurer & ground survey	Insurer paid loss records	Variable
Contract Periods	Quarterly or Annually	Semi-annually	Variable
Contract	Aggregate	First Event Second Event Aggregate	Variable
Contract Size	Option spread x $200	$5,000	Variable
Premium Cash Value	Index points = $200	$ Amount	Variable
Type	Proportional	Binary	Variable
Settlement Period	6 months	Partial, Full, 1st	Variable

	12 months	Update, 2nd Update, 3rd Update	

Bermuda Stock Exchange (BSX)

15.16 The Bermuda Stock Exchange has committed itself to go live by 15 July 1998 with its Insurance Market Index. The index, which was originally set for launch in January, measures the stock market performance of insurers and reinsurers based on the island. The index was created by FT-SE International, and is market capitalisation weighted with trading prices taken from the primary markets and fed in to index calculation software at BSX.

15.17 Companies likely to be tracked by the index included Annuity & Life Re, ACE, EXEL, IPC RE, LaSalle Re, Mid Ocean Re, Mutual Risk Management, Partner Re, Renaissance Re, Stirling Cooke Brown and Terra Nova.

15.18 The index will initially be tradable in the form of an index-tracking fund, and later in the form of an index options contract, enabling investors to invest in the offshore insurance market in a single transaction.

15.19 Indices for catastrophe bonds and Marine insurance risk are also being considered by BSX, who are also working with CATEX to launch a Bermuda-based electronic trading and communications system, CATEX (Bermuda) through which members could exchange or purchase risk and trade-related index-based derivative products. CATEX (Bermuda) which was to have been up and running in November 1997, will be open to insurers and reinsurers, brokers and traditional market players such as investment banks and hedge funds, with the aim of bringing primary risk traders the traditional capital markets closer together.

16 The Failure of CBOT Insurance Futures

16.1 Despite features which make insurance futures attractive - reversibility, CBOT Clearing Corporation guarantees on all transactions and low transaction costs - these contracts never achieved the high trading volumes envisioned by CBOT. Consequently, insurance futures contributed little to the overall capacity of the (re)insurance market.

16.2 The following table shows the growing preference over 1993 for options contracts over futures contracts.

16.3 CBOT claimed that the low trading volume was due to the unfamiliarity of market participants with the new product.

Year 1993	Eastern Catastrophe Futures	Eastern Catastrophe Options	National Catastrophe Futures	National Catastrophe Options	All Contracts Value ($m)
January	220	8	241	6	11.99
February	215	0	256	0	13.39
March	570	0	571	0	16.36
April	940	0	997	0	13.30
May	771	10	788	0	13.99
June	784	83	791	0	14.19
July	501	208	484	0	16.01
August	377	165	392	2	15.51
September	178	200	218	0	16.44
October	44	1643	44	4	14.96
November	2	1667	1	3000	19.66
December	0	119	0	440	12.97
Year total	4580	4103	4783	3424	

[source: Financial reinsurance & futures newsletter, issue No. 29, January 1994]

16.4 The problems with catastrophe futures were:

- Insufficient information to quantify and manage basis risk;
- Pooled information was based on incurred losses and therefore subject to case estimation variability across insurers as well as not making any allowance for IBNR
- Lack of understanding of the product by potential market participants

16.5 More importantly, options were considered more attractive by the insurance industry as they allowed potential hedgers to effectively replicate layers of insurance cover via option spread strategies. Such strategies contribute substantially to the overall trading volumes of options.

16.6 As a consequence, CBOT launched their new PCS index-based Catastrophe Options late in 1995. Insurance futures contracts have since ceased trading.

17 Example of hedging with PCS Catastrophe Options

17.1 A typical strategy used by an insurer is to use a call option spread to replicate the purchase of a layer of catastrophe excess of loss reinsurance. This involves buying call options (with strike price determined by its relation to the lower limit of the layer) and selling the same number of call options with the same expiry date but with a strike price related to the layer's upper limit.

17.2 As an example, consider an insurer who writes around 0.5% of the industry gross premium in a particular geographic region covered by the PCS index.

17.3 Consider how this insurer might replicate the purchase of a traditional $30m xs $10m catastrophe reinsurance using PCS Catastrophe Options.

17.4 Assume the insurer's loss experience is aligned to that of the industry (in practice, this is not the case, and the following methodology is adjusted to make approximate allowance for the relative severities of the insurer's and the industry's loss experience.

17.5 As discussed in the previous section, the index represents $100 million per point, and the value of one option contract is $200 per point.

17.6 The insurer's attachment point of $10m corresponds to an industry value of

$$\frac{\$10m}{0.5\%} = \$2b$$

17.7 At $100m per point, this equates to a lower strike price of 20 points,

17.8 Similarly, the upper limit of $40m corresponds to

$$\frac{\$40m}{0.5\%} = \$8b$$

17.9 This equates to an upper strike price of 80 points.

17.10 Therefore the insurer's $30m xs $10m reinsurance protection is approximated by a 20/80 call spread. This corresponds to an industry loss in the range $2 billion to $8 billion.

17.11 How many call spreads should the insurer buy? The value of each index point is $200. Therefore the protection provided (depth) of each call spread is:

$$(80-20)\times\$200=\$12{,}000$$

17.12 The required depth is $30m, so the number of 20/80 call spread contracts which are required is:

$$\frac{\$30m}{\$12{,}000}=2{,}500$$

17.13 Therefore, to replicate a traditional $30m xs $10m catastrophe reinsurance, the insurer buys 2,500 call options at the strike value of 20 and sells 2,500 call options at the strike value of 80.

17.14 This is bundled up into 2,500 20/80 call spreads. This bundling has an impact on the margin call, which effectively becomes a net margin.

BANKING AND INSURANCE

18 Introduction : Arbitrage Opportunity?

18.1 Sometimes the insurance and banking industry are trying to examine and measure exactly the same thing. However, differences in approach, terminology, perspective and even the historical separation of the industries can sometime disguise the fact that the same measure is being analysed and quantified in two very different ways.

18.2 Consider the case of the credit risk of a company. Would this risk be an insurance risk or a banking risk? Is there any difference?

18.3 An investor will expect a higher return on a corporate bond than a gilt. This difference return may be very small (e.g. debt issued by ICI) or relatively large (e.g. from a junk bond).

18.4 This excess return compensates the investor for the risk that the company will default on its loan obligations.

18.5 In insurance terms, this excess return is the premium required to cover the credit risk of the company.

18.6 An insurer might suggest that a company insure the corporate debt that they issue, and thus be able to issue it at a lower yield, due to the increased security. Effectively the premium for the credit risk would then be paid to the insurance company, rather than being reflected in the price of a bond.

18.7 This example is a direct illustration of the Insurance and Banking markets addressing the same problems in very different ways, with different terminology and with a different mechanism for quantifying the measures involved.

18.8 In this particular example, one measurement of price is made by insurers assessing the credit risk of specific companies, and the other is a market driven price, dependent upon the credit risk for companies with that credit rating, and also additional factors such as liquidity and demand.

19 Gearing - Some Misunderstandings

Capital Efficiency

19.1 Both Insurance Companies and Banks look at risk and capital, but their perspective and even their language can be very different.

19.2 There is the potential for significant actuarial involvement in bringing these markets together. However, whilst many actuaries have the mathematical skills and knowledge of the insurance industry, to be instrumental in shaping the future of the two industries, the level of knowledge regarding the intricacies of banking and deal-structuring needs to be improved.

19.3 It is important to recognise that there are two forms of holders of instruments: investors and trading businesses. Investors buy securities to match or fund a portfolio of liabilities. This is the traditional actuarial perspective. Trading businesses purchase instruments in order to capture in order to expose themselves to specific operational risks in order to produce a return to their shareholders.

19.4 Banks have two functions:

- Product origination: Creating an asset by borrowing and lending (e.g. bank deposits and mortgages) and releasing the asset to the capital markets (e.g. mortgage backed securities).
- Proprietary Trading: Creating a return to shareholders through returns from a portfolio of interest rate, credit and currency risks.

19.5 Insurers have two functions:

- Business function, involving the purchase of a portfolio of risks
- Investor function involving the holding of securities to match or fund the liabilities.

19.6 It has been stated that catastrophe bonds cannot compete with traditional reinsurance because they are capital inefficient due to their fully colateralised nature.

19.7 Indeed, insurance can be highly capital efficient where the risk premium is small relative to the cover provided.

19.8 However, where the risk premium is large compared to the cover provided it is possible for a securitised insurance bond to be more

tax efficient than insurance due to the differing regulatory environments.

19.9 Note that insurance is most capital efficient where the credit risk to the insured is highest. The same reasoning also drives the creation of captives, large retention's and retro plans for smaller risks (these are in essence banking products).

19.10 This is driven by the fact that there is a difference in the insurance capital requirement between the *economic capital requirement* and the *regulatory capital requirement*.

19.11 The capital requirements for an insurer are: a percentage of the premium written; capital required to support prudent reserving. The current minimum requirement is approximately 16%.

19.12 The capital requirements (for a bank) to hold a catastrophe bond are: a percentage of the market value of the bond, the remaining capital deposited into the bond is economically released back to the investment market through a SWAP. The current minimum requirement is approximately 8%.

19.13 The capital requirements for a conduit or hedge fund to hold a catastrophe bond are that required to maintain its rating.

"Free Money" - Why banks are not like ordinary investors

The Advantages of Being a Bank

19.14 A financial institution can acquire assets using deposits borrowed from the inter-bank market (apart from the capital requirement i.e. 8% of the value). The cost of its funds for this operation is LIBID. Banks aim to free up this capital as soon as possible via a process called asset securitisation.

The Advantages of Being Big - the CP market

19.15 Many large corporations are just as credit worthy as banks. As a result of this a market for short term unsecured loans called commercial paper developed in the US. This allows major corporations such as GE Capital to acquired funds for projects at approximately LIBOR (typically +/- 3BPs).

Conduits

19.16 These are essentially non-banking regulated financial organisations. The key difference is that they are not funded by deposits to individuals but via unsecured loans / commercial paper made into the professional investment market. They do not have any

statutory regulation but instead rely on the rating agencies in order to access the market for funds.

19.17 These vehicles are set up as SPV managed (under contract) by a bank. The level of gearing involved for these structures is very high, for example a typical high quality conduit may purchase $10bn of A grade bonds on the back of a investment grade subordinate loan of $400m which is made by the bank supported by $32m of equity capital (some of which could by subordinated loans to the bank). The gearing on the bank's equity of this structure is over 300 fold.

20 Some Products Compared

Introduction

20.1 Two of the main differences between insurance products and banking products are *indemnity* and *tradeability*. Catastrophe bonds and insurance securitisations are now crossing these boundaries and increasingly blurring the distinction between these two historically separate markets.

20.2 In this section, we explore the similarities and differences between the Banking and Insurance market places, and illustrate how risks are analysed and carried. (These are all generalisations and so do not reflect the diversity and complexity of each set of instruments.)

20.3 Different products in the two markets can often be used to produce similar results. As illustrated in the introduction to this section, this could introduce the potential for arbitrage across the two markets, arbitraging the different techniques used to analyse and quantify similar risks.

Derivatives vs. Insurance

20.4 An insurance contract is an *indemnity* agreement to make good some defined loss to the insured. A derivative is a contract to pay a mathematically defined sum.

20.5 The crucial difference here is that a derivative can be used to trade, invest and profit, whereas the payout on an insurance is limited to indemnity.

20.6 The insurer is protected (to some extent) from the behaviour of the insured by the indemnity nature, and also the good faith principle, of the transaction. This risk is removed from derivatives by the use of market indices.

20.7 Credit risk is mitigated in derivatives by a mark to market arrangement (where a cash sum is paid to a trust or clearing house reflecting changes in the intrinsic worth of the contract). In comparison the credit risk for known outstanding claims usually remains with the buyer of an insurance contract.

20.8 The writer of a derivative is involved in liquidity risk **whereas** the purchaser of an insurance contract has credit risk.

Financial Insurance vs. Contingent Funding

20.9 In a financial insurance/reinsurance contract, a company places funds in reserve on deposit with an insurer which can be withdrawn contingent on an event. The insurer should make a profit through access to cheap funding.

20.10 A contingent funding arrangement is an arrangement to make a loan to a company at pre-agreed terms (usually subordinated to appear as economic equity) should an event happen. The underwriter makes money through a commitment fee.

20.11 These contracts achieve similar purposes: funding for an event. The choice depends on whether profits to pay for the event are likely to emerge before or after it occurs. In both cases the contracts are written in such a way that the cost of the claim/drawing can be recovered. The risk transferred is one of liquidity and not that of the claim. However the risk borne by the provider includes the credit risk of a severe claim causing the cedant to become insolvent. This risk is usually mitigated by clauses restricting utilisation under severe circumstances.

Risk Securitisation vs. Asset Securitisation

20.12 Asset-backed securitisation involves the purchase of a stream of future income, such as anticipated future royalties on David Bowie's records. (Seriously! David Bowie raised $55 million through a bond issue in this way!)

20.13 Risk-based securitisation involves purchasing a bond, whose repayments are dependant upon some pre-defined risk, e.g. catastrophe risk etc.

20.14 Asset Securitisation involves the purchase of a set of future Receivables (the asset) within a special purpose vehicle. This transaction is funded by a series of bonds that are subordinated in a particular order. Sufficient equity will be placed in the vehicle to absorb expected losses.

20.15 If the asset performs as expected then all the bonds will pay off, otherwise some of the junior notes will default. This can be seen as similar to a structure note apart from method of construction.

20.16 In risk securitisation the vehicle prefunds the maximum possible losses under a liability contract. The performance of the issued bonds is structured so as to be similar to the junior pieces of debt issued under an asset securitisation.

Finite Reinsurance vs. Risk Securitisation

20.17 A finite reinsurance contract involves the transfer of a limited amount of risk to the insurer, via mechanisms such as profit commission, additional premiums.

20.18 Similar risks are transferred to investors via risk securitisation. For example in the mortgage backed bond area the risk of repayment of fixed rate mortgages is borne by the bond holders.

20.19 A possible future development is that both financial and finite risk products will be transferred to the capital markets via securitisation.

Structured Notes vs. Risk Securitisation

20.20 A structured note is effectively a bond where the return is dependent on the performance of a portfolio of derivatives and other financial instruments. These can be equity market related, commodity related, interest rate related etc.

20.21 The market for such bonds exists because investors want to achieve additional returns above that available on conventional debt instruments and other investors have risks they wish to remove held in the form of derivatives and other instruments. The structured note allows the removal of gearing from the derivative.

20.22 Structured notes are issued by special purpose vehicles which use the proceeds to purchase the various component instruments.

20.23 There is little difference between a structured note and a risk securitisation other than the regulatory treatment required of the vehicle used to issue the bonds (e.g. for a cedant to be able to reduce its balance sheet liabilities by showing them net, the vehicle must be a reinsurance company).

Credit Derivatives vs. Bond Insurance

20.24 A credit derivative is an instrument where for an initial premium an investor agrees to make good credit losses on a particular benchmark bond. Again, this is not insurance, as the payments are not necessarily linked to an actual loss suffered.

20.25 A similar arrangement is the total return swap where two investors exchange the return on two instruments over a set period (interest and market value).

20.26 Bond insurance involves guaranteeing of the principle and interest receipts of a set of notes for a premium.

20.27 These types of business are very similar with the exception of liquidity risk vs. credit risk as discussed above.

20.28 Pricing of credit derivatives is based on market-driven pricing and ability for hedging. Insurance pricing is based on an insurer's own assessment of their underlying risk.

20.29 [A notable feature of credit derivatives for low credit quality bonds is that they are not priced via Black-Scholes methodology as the performance of the asset cannot be modelled by a diffusion process. (A diffusion process requires continuous hedging, however credit derivative prices can jump, affecting liquidity and thus the ability to truly hedge). Current techniques for pricing are similar to that used by the insurance industry. There is however research into suitable extension to the theory being undertaken for use in pricing of low credit quality derivatives and catastrophe derivatives.]

"Ordinary" Debt and Equity

20.30 By investing in a company's debt or equity capital an investor can gain exposure to a package of different risks. This is sometimes referred to as general capital.

20.31 However the new instruments allow specific risk taken by investors, and for this to be controlled and managed by the investor (or on their behalf). This bearing of specific risk for a specific return is sometimes referred to as specialist capital.

20.32 The purpose of specialist capital is to allow the management of the company to concentrate on running the companies business without undue worry over other uncontrollable incidental risks. Insurance is a form of specialist capital from a corporate point of view.

20.33 The purpose of general capital is to take management, company business and limited residual risk and reward.

Weather Derivatives – An example of a banking and insurance product

20.34 Weather derivatives are financial instruments that allow firms to hedge weather-related revenue risk. Any firm whose business is in some way dependent on the weather, for example ski operators or the agricultural industry, may consider purchasing an instrument which would pay off in the event of warmer or colder than expected weather. (In principle any facet of weather could be

hedged - vineyards may want protection against too much rain at important times of year for instance.)

How would they work in practice?

20.35 Over the autumn and winter of 1997 a number of US companies began trading weather derivative products. The initial players have tended to be major oil and energy companies who are used to using the futures markets to hedge their results.

20.36 The first products have all been temperature related and are linked to an index of cumulative "degree days" over a specified period. The average temperature during a day is compared with a fixed reference temperature (usually 65°F), and the difference (in °F) is the number of degree days recorded for a given day. Over the contract period these degree days are aggregated to produce the index. (Positive and negative variations are also recorded separately). For each degree day of difference from an agreed "strike price" at the end of the contract an agreed sum of money will change hands.

20.37 In order to ensure that the index is calculated objectively, the number of degree days contributed each day is calculated from daily average temperature data provided by the US National Weather Service. Similar indices would have to be constructed by a body like the Met Office if the same methodology were to be attempted in the UK.

How successful have they been?

20.38 Initial interest in weather derivatives in the US has been promising, and it has been widely reported that "several hundred" contracts are believed to have been traded over the 1997/8 US winter season. Maximum potential payouts have varied between $100,000 and $100 million. At this point in time all of these weather derivative deals have been over-the-counter transactions. Bodies like the Chicago Board of Trade and the New York Mercantile Exchange are believed to have expressed interest in these products and may consider the possibility of trading a standardised weather contract. There has recently (June) been a conference held in Houston by members of the energy industry to discuss the benefits of weather derivatives as a risk management tool, and Enron Capital and Trade Resources (one of the energy companies involved in the early deals) has advertised on the Internet for people to administrate their weather derivatives book.

20.39 The benefits of temperature derivatives for the energy industry are fairly clear. As well as being able to hedge supply prices with gas

and oil futures they can now hedge against changes in consumer demand. The benefits for other industries are not so clear cut, and it is difficult to envisage individual farmers and their like entering the derivatives market with quite the enthusiasm of the energy giants. Nevertheless these new products will be well worth watching over the summer months, when colder than average days will reduce consumer spending on powering air conditioning units and refrigeration.

Insurance or Banking?

20.40 Would a weather bond be an insurance product or a banking product?

20.41 It is already possible to buy insurance against weather fluctuations. So a weather bond could be the capital markets in direct competition with the insurance industry.

21 Rating Agencies

Introduction

21.1 Rating agencies play a key role in the international bond markets providing an important service to investors. They provide an independent assessment of the credit quality of bond issues. Clearly the credit quality of an issue, as a measure of the risk of default, effects the margin that has to be paid above LIBOR or a bench-mark bond.

21.2 Although rating agencies will tend to look at various structures and their associated risks in broadly similar ways there can still be significant differences of approach on certain issues.

Purpose

21.3 A rating agency is an independent body employed to give an opinion as to the quality of a promise made by an organisation. They exist to enable investors who don't have the expertise to judge an offer for a particular instrument.

21.4 Rating agents originally where concerned with the security of debt issued by major corporations. They also give opinions on the financial strength of major life and general insurers. In respond to the investor demand the have also begun to rate mortgage pools, bond funds, structure notes, asset backed securities and insurance backed securities.

21.5 Ratings are divided into two broad categories, investment grade and sub-investment grade. Sub investment grade ratings are described are speculative. The idea is that two instruments with similar ratings should have broadly similar quality. The benchmark for ratings is ordinary corporate bonds.

Analysis Techniques

21.6 Rating agents employ two broad methodologies to analyse bonds: multiples of historic losses and expected loss. The reasoning behind this is discussed below. (Note however that different agencies have slightly different methodologies and so can produce slightly different answers.)

21.7 A multiple of historic losses approach will be used when the key driver of the loss within an instrument is *parameter uncertainty*. For example losses experienced on a consumer loan portfolio is a function of the underwriting quality and economic conditions, rather than stochastic error within a large portfolio.

21.8 The rating agent determines a *base loss* figure (i.e. the expected loss) by benchmarking the portfolio and uses the distribution of historic performance of the benchmarked portfolio to determine what multiplier (*stress multiple*) of base losses is required for the bonds to survive to achieve a given rating.

21.9 It is likely that should a securitisation of a insurance portfolio's retention be issued (say of a motor book) that this approach would be taken.

21.10 An expected loss approach will be used when the key drive of the loss is the stochastic performance of the underling assets (an additional small margin will usually also be taken in the expected performance of the asset). For example loss experienced on a portfolio of corporate bonds (usually 20 to 50 bonds).

21.11 The rating agent will calculate the expected loss on a prudent basis relative to the promise that has been made. The promise made is (unless an explicit promise is made to investors say of 2% excess return) assumed to be for the bond to make a market rate of return. This means the loss in any particular scenario is the larger of zero or the net present value of the promises less the net present value of payments received (discounting is made at the risk free rate of return).

21.12 The expected loss calculated is then compared to the expected loss (as calculated above) of corporate bonds that have a net present value of zero. Thus the credit rating is a measure of *downside risk only*.

21.13 This approach is either implicitly or explicitly followed in the multiples approach discussed above; either the multiples are selected such that historic losses on the benchmark portfolio would have approximately been equal to the required loss or a distribution is explicitly assumed for the parameters and the expected value assessed.

21.14 This is the approach that is taken for the rating of catastrophe backed notes that have been the main feature of the securitisation market to date.

The Approach to Rating Catastrophe Bonds

21.15 As an indication of how rating agencies carry out their analysis, set out below is an outline of the approach of one of the leading agencies (Fitch) to rating cat bonds.

21.16 Each deal is examined on an individual basis taking account of the specifics of each bond. The analysis carried out involves rigorous due diligence, an understanding of the models used to estimate loss and a comprehension of the factors affecting bond performance.

21.17 To assess the bond performance of a bond series linked to a particular type of catastrophe, the agency uses models to understand the following areas:

- the catastrophic event
- the conditional loss amount and
- the structure of the transaction

21.18 The incidence and severity of the catastrophe is modelled stochastically using a frequency-intensity model. Appropriate distributions are selected and parameters estimated with assistance from external consultants if necessary. Any interdependencies between variables are also considered.

21.19 Given a particular event has occurred, a conditional loss model is used to estimate the damage incurred, taking into account both property specific attributes and local or regional features.

21.20 The transaction structure is modelled to reflect other features of the bond construction which may affect the amounts and timing of cashflows to potential investors.

21.21 Other factors taken into account in determining the extent of losses include:

- data quality
- policy coverage
- demand surge
- geographical concentration,
- loss management and

- portfolio growth rate and mix.

21.22 Models are validated using statistical procedures and empirical and simulated stress scenario checks.

21.23 The above approach does not explicitly deal with the rating of index-linked catastrophe bonds. However, it is likely that the rating agency would select appropriate catastrophic event and conditional loss models, appropriate to the underlying index, which would not depend on the details of the particular transaction. This would leave only structural aspects particular to each bond issue to be separately modelled.

Historic Losses

21.24 Show below are the "idealised losses" for one of the rating agencies (Moody's). These are the target expected loss figures that a bond should show to achieve a particular rating.

Moody's "Idealized" Cumulative Expected Loss Rates (%)										
	Year									
Rating	1	2	3	4	5	6	7	8	9	10
Aaa	0.000028	0.00011	0.00039	0.00099	0.00160	0.00220	0.00286	0.00363	0.00451	0.00550
Aa2	0.000748	0.00440	0.01430	0.02585	0.03740	0.04895	0.06105	0.07425	0.09020	0.11000
A2	0.005979	0.03850	0.12210	0.18975	0.25685	0.32065	0.39050	0.45595	0.54010	0.66000
Baa2	0.093500	0.25850	0.45650	0.66000	0.86900	1.08350	1.32550	1.56750	1.78200	1.98000
Ba2	0.858000	1.90850	2.84900	3.74000	4.62550	5.37350	5.88500	6.41300	6.95750	7.42500
B2	3.938000	6.41850	8.55250	9.97150	11.39050	12.45750	13.20550	13.83250	14.42100	14.96000
Caa	14.30000	17.87500	21.45000	24.13400	26.81250	28.60000	30.38750	32.17500	33.96250	35.75000

21.25 These figures are consistent with historical bond default and recover assumptions, or in insurance terms frequency of loss (default) and 1-%Loss to layer (recovery).

21.26 Assuming historic performance statistics and current risk free discount rates it is simple to calculate the required margin on a bond of a particular rating such that the expected return is a market rate. This margin can be regarded as a risk premium for the

default risk compared to the spread on the bond, which is the analogue of the full premium.

21.27 From Moody's default studies, analysing the historic rate of corporate defaults, the required margin for a BB rated security from would be 99 basis points above LIBOR, whereas the yield on the Goldman Sachs BB high yield index (at March 16 1998) was 174 basis points (to 6 month LIBOR). Therefore the difference (174-99 = 75 basis points) represents the market's excess return requirement (over expectation) for taking the increased risk of default.

21.28 In addition the cost of issue of BB paper can be considered to the brokerage required and expenses, for BB paper this may reach 2%-3% of original balance which has to be amortised over the loans term (reasonable short for high yield corporate paper say 5 years)

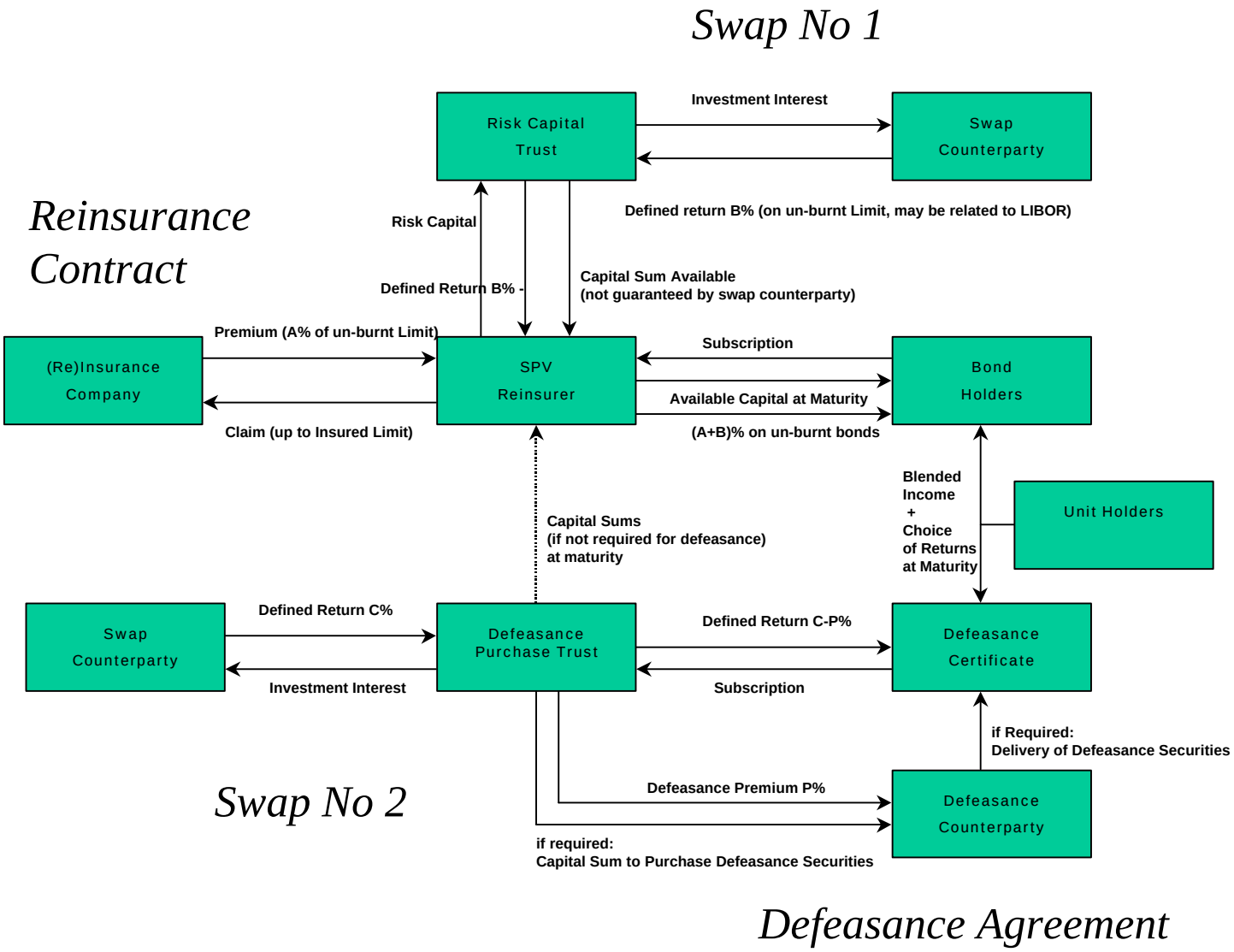
21.29 To put this is reinsurance terms, in order for the investment market to bare a 1% corporate default risk (pa over a 5 year term) it will cost approximately 174 + 250/5 = 2.24%.

22 Typical Securitisation Structure

Introduction

22.1 How does securitisation actually work? The diagram below shows a "typical" securitisation structure, and illustrates at a glance how complex some of these structures can get.

22.2 Not only is the structure something new for insurers and actuaries, but the terminology can introduce new concepts and issues.



Special Purpose Reinsurer

22.3 In order to issue a contract for indemnity the special purpose vehicle must obtain an insurance license. This required the company to operate in a friendly regulatory environment which do not impose excessive capital requirements. In addition the environment must be tax efficient and satisfy the home regulators (if any) of the company receiving the coverage. This requirement is similar to that of a captive insurer.

22.4 Typically a Cayman island's company has been used register under a class B license as a restricted purpose insurer.

22.5 For US insurance companies using securitisation, the assets of the SPV Reinsurer will be held in a regulation 114 trust to allow the reinsurance to be counted for solvency (even though the SPV is not an admitted insurer in the US).

Bankruptcy Remoteness

22.6 This requirement is imposed to put "clear blue water" between the reinsured company and the vehicle issuing the debt. This is achieved by giving the equity capital of the SPV to a charitable trust. The articles of association of the company will include clauses restricting the companies business to undertaking the defined reinsurance contract.

22.7 In addition it is not desirable that the SPV become insolvent. This can be guarded against by limiting the reinsurance contracts losses to the funds available in the SPV and by preventing the bond holders from petitioning the companies bankruptcy by a covenant on the bonds.

Expenses

22.8 The expenses involved in the securitisation of an insurance risk are bond underwriting fees, structuring and legal fees, ongoing expenses of the vehicle (trustee, accounting, rating agency and administration fees). There are also the expenses involved in any SWAP, Guaranteed Investment Contract or other financial instrument required as part of the deal.

The SWAP

22.9 It is important that the assets held by the SPV generate exactly the required rate of return such that the bond's coupon can be made. Any excess return left in the vehicle would expose that capital to

loss for no additional benefit, whereas any shortfall would result in default on the coupon.

22.10 This is achieved by firstly a restriction on the assets that the SPV can invest in (normally the risk of default is minimal as the highest short term rated noted is specified). Secondly the vehicle entering into an interest rate SWAP on the assets held with a AAA rated counter-party to produce the required rate (principle default risk is usually left in the vehicle). This required rate is below the rate earned on the assets so in the event of counter-party default the SPV is likely to be able to pay the coupon and it will be possible to find a replacement SWAP (the contract being intrinsically profitable).

22.11 This arrangement has another desirable side effect in that the expected SWAP profits can be used to fund the set up expenses (either explicitly or by provide a cheap source of funds for the sponsoring bank and hence profit).

22.12 An alternative to the use of a SWAP is a guaranteed investment contract (GIC) which is essentially a guaranteed deposit rate for the funds. However, because of the credit risk concentration involved, this approach is unlikely to be used.

Defeasance

22.13 Defeasance is the legal discharge of a loan obligation by the delivery of another debt instrument issued or guaranteed by the US government.

22.14 This is used to 'guarantee' a proportion of the principle of certain notes for one of two purposes:

- Dilute the credit risk with the instrument to allow a higher credit rating to be obtained and hence access to a wider market
- Allow the bonds to achieve a AAA rating against the promise of return of principle only.

22.15 Defeasance is typically achieved by the following method: firstly the funds held by the reinsurer are separated into two trusts, one providing security for the reinsurance contract, the second providing funds to purchase defeasance securities; secondly a purchase agreement with a AAA defeasance counter-party is arranged. The defeasance counter-party will deliver the required security on occurrence of the reinsured event for the funds held in the trust in exchange for a premium each period.

Termination Clauses

22.16 An advantage of securitised reinsurance contracts is that they can provide guaranteed rates over several years. In order to prevent selection against the bondholders (by deliberate invalidation of the reinsurance agreement) the contract will contain a clause requiring the net present value of the future premiums outstanding (at risk free rates) to be paid into the vehicle and to the bondholders should the reinsured default on their premium obligations.

22.17 Additional (non-penalised) termination events will be included to allow the scheme to quickly unwound should adverse tax or regulatory rulings effect its operation.

APPENDICES

23 Appendix A - Swiss Re

Introduction

23.1 Swiss Re is the world's second largest reinsurance company and a strong participant in the area of securitisation and alternative risk financing.

23.2 The risks covered under this deal is Californian Earthquake exposure as measured by the PCS loss index and it is believed that Swiss Re used the issue to reduce exposure it had gained from participating in the Californian Earthquake Authority programme.

23.3 Swiss Re were advised in the transaction by their own alternative risk department and Credit Suisse First Boston.

Structure

23.4 The notes were issued by a special purpose vehicle, SR Earthquake Fund domiciled in the Cayman Islands which in turn issued a reinsurance cover to Swiss Re.

23.5 The notes were issued in four tranches with a total nominal value of $137M.

- 1. Class A-1. Floating rate. Notional amount $42m. Rating Baa3. 40% principal protected. One-third of principal at risk is lost at market losses of $18.5bn, the next third at $21bn and the remainder at $24bn.
- 2. Class A-2. Fixed rate. Notional amount $20m. Otherwise as above.
- 3. Class B. Fixed rate. Notional amount $60.3m. Rating Ba1. No principal protection. Triggers as above.
- 4. Class C. Notional amount $14.7m. Unrated. All principal lost of market losses exceed $12bn.

Analysis

23.6 The deal was increased from an initial issue of $112m.

23.7 Key factors in this were:

- the assignment of an rating from Moody's (using information from Eqecat's Catastrophe models).
- the structure of the deal - giving a range of risk/reward pay-offs and therefore appealing to a range of different investors

24 Appendix B - La Salle Re

Introduction

24.1 La Salle Re is a Bermuda based reinsurer writing global based risks and one of a number of such reinsurers established in the last hard market which led to the last significant flow of capital to the insurance industry.

Structure

24.2 The structure of the deal was a $100m Cat-E-Put (or contingent equity facility) like the earlier RLI & Horace Mann deals.

24.3 It gives La Salle Re the option to issue $100m of convertible preferred shares at pre-arranged terms following a catastrophe. The price of the deal is $2.35 p.a. for three years.

24.4 The catastrophe trigger is either a single event exceeding $200M or an aggregation of $250M from smaller catastrophes.

Analysis

24.5 La Salle Re stated the reason for the deal as ensuring that, following a major catastrophe which is likely to hit most of the market, they will be able to spend their time most profitability underwriting risk in a hard market without having to raise capital first.

24.6 This deal was arranged by Aon but was the first of its type to be syndicated with Option writers being:- European Re (Swiss Re subsidiary and lead investor), Allianz, Aon & CNA (both founding shareholders of La Salle Re).

25 Appendix C - Tokio Marine

Introduction

25.1 Tokio Marine is Japan's leading insurance company.

25.2 The risks covered under this deal were Tokyo earthquake risk, with losses measured by the physical parameters of the disaster.

25.3 The bond was issued through a special purpose vehicle - Parametric Re located in the Cayman Islands. For Japanese regulatory reasons the actual reinsurance coverage to Tokio Marine was provided not by the special purpose vehicle but by Swiss Re who, in turn, retrocede their risk to Parametric Re.

25.4 The deal was marketed and co-lead by Swiss Re New Markets and Goldman Sachs.

Structure

25.5 The deal was issued in two tranches both with ten year maturities:

- 1. $80mn of Principal variable notes. Rated Ba2/BB. Paying LIBOR plus 430 basis points. The principal of these notes is entirely at risk

- 2. $20mn of partially defeased "units" consisting of notes and defeasance certificates. Rated Baa3/BBB. Paying LIBOR plus 260 basis points. The principal of these units is only partially at risk with a guaranteed repayment of around $10mn. In essence the "units" are made up of around 50% principal variable notes and 50% A-1 rated commercial paper which are swapped with Swiss Re to pay LIBOR less 12 basis points. The units are strippable into their two components.

25.6 The total amount of the deal gave $90m reinsurance protection.

25.7 The trigger for losses was earthquakes of location in two grids (Inner and Outer) in the Southern Kanto region of Japan (which centres on Tokyo), of depth less than 61 kms and magnitude greater than 7.1 (for the Inner grid) or 7.3 for the Outer Grid all as measured by the Japan Meteorological Agency.

25.8 The loss triggers were then on a sliding scale. For example for the Inner Grid, 25% of the capital at risk is forfeited on an earthquake of magnitude 7.1 up to 100% for magnitude 7.6.

25.9 Ratings were provided by Moody's and Duff & Phelps, based on earthquake modelling provided by the seismic hazard consultancy EQE

Analysis

25.10 The deal had a number of distinguishing features:

- the first securitisation issue to cover Japanese exposure
- the first to use a parameter based trigger (hence the name of the Special Purpose Vehicle) rather than an insured loss trigger (based either on the issuer's own losses or on market losses as estimated by an index).
- an unusually long period of cover of 10 years. This was made possible by the parametric trigger which meant that the bond returns were not subject to the risk of changes in the insured portfolio. This was particularly important as Tokio Marine are expecting significant (but unknown) increases in the amount of earthquake cover they provide, over that period

25.11 Tokio Marine issued the bond so as to diversify their sources of reinsurance. Although the coverage involved is less than 10% of their total exposure to a Tokyo earthquake. They have subsequently stated that they make look in future to issue a bond based on typhoon losses.

25.12 Around 70% of the deal was placed with US investors, 10% in Canada and 20% in Europe. Interestingly none of the risk was placed with Asian investors.

26 Appendix D – Joint Florida Underwriting Association

Introduction

26.1 The bond covered Florida hurricane risk underwritten by an insurer in the Zurich Group, which has been established since 1996 and which (to date) assumes risks from the Florida Residential Property and Casualty Joint Underwriting Association.

26.2 This insurer then has a reinsurance contract with Centre Solutions – a Bermudan reinsurer in the Zurich Group which is in turn reinsured by the special purpose vehicle for this deal – Trinity Re, located in the Cayman Islands.

26.3 The investment managers were Scudder Kemper (100% owned by Zurich) and Zurich Capital Markets. The bond was issued by a form of auction based on a range of possible coupon spreads.

Structure

26.4 The basic reinsurance contract is for 90% of $80M excess $40M (with the 10% provided by a co-insurance arrangement with a member of the Zurich group) for a period from the 23 February 1998 to 7 December 1998.

26.5 The parameters of the deal were based on comprehensive and complex, stochastic hurricane modelling carried out by RMS (30% owned by the Zurich Group) which calculated a level of prospective expected loss based on estimated exposures.

26.6 Post any event (i.e. a hurricane), the retention is adjusted depending on the Florida Hurricane Catastrophe Fund Reimbursement.

26.7 In addition, following an event, the contract specifies that RMS are to re-model the initial expected loss (using the same model as at outset but updated exposure data). If the expected loss has increased by more than 5% then the parameters of the reinsurance contract will be altered (by increasing the % co-insurance) so as to reduce the risk back to its initial expected level (plus 5%) and the loss assessment to the arrangement is then based on this revised structure.

26.8 There are two types of notes:

- 1. $22.036M of Class A1 – Extendible Principal Protected. Originally offering LIBOR + 165-180 basis points. Repayable at

31 December 1998 (if no loss) or at 31 December 2009 (if there is a loss). Rated AAA/Aaa.

- 2. $61.533M of Class A2 – Principal Variable. Originally offering LIBOR plus 395 to 425 basis points. Repayable at 31 December 1998 (if no loss) or possibly at 31 December 1999 (if there is a loss – depending on whether it exhausts the cover). Rated BB/Ba3.

Analysis

26.9 The bond is believed to have been ultimately over-subscribed – although it appears that it was not as easy to place as other deals around the same time.

26.10 Reasons for this appear to include the lack of an index (with losses based on the ultimate net losses of the insured) and the complexity of the deal – particularly the modelling and re-adjustment of the risk

26.11 Industry comment has implied that the deal was much more keenly priced than other securitisation deals, offering a rate on line that was very competitive compared to conventional reinsurance (so that most insurers and reinsurers – the traditional buyers of catastrophe bonds – were unwilling to subscribe).

26.12 Some industry comment has suggested that the yields were at the top end of the original range, but other sources imply that the Class A2 bonds were eventually placed at only 367 basis points over LIBOR and this would seem consistent with the comments above.

26.13 This yield can be compared (in very broad terms) to a range of other catastrophe bonds, all of which were rated around BB and which had an expected loss of around 80-100 basis points.

26.14 Note for comparison that a conventional high-yield BB rated corporate bond would yield around 200 basis points over LIBOR.

26.15 These bonds, in order of issue, with their coupon over LIBOR, are:

- USAA (1st issue) 576 basis points
- Swiss Re 475 basis points
- Tokio Marine 430 basis points
- USAA (2nd issue) 400 basis points

- Yasuda 370 basis points

26.16 Secondary trading in the issue should be improved by the use of a "book entry" system where trades are logged in a register rather than relying on the physical exchange of certificates as has been the case in other recent deals.

26.17 Just one day after the bond went on risk the state of Florida was hit by its worst ever tornado with around 40 people being killed. This did not, however, impact on the bond which only reinsures hurricane losses (as defined by the National Weather Service).

27 Appendix E - Matsui Marine & Fire

27.1 This deal is similar to the Tokio Marine deal in that it has the same (parametric) trigger and was marketed by the same investment groups.

27.2 Differences are as follows:

- reinsurance coverage is only for a period of three years from 1 April 1998
- coverage is only for $30m – which avoided the need for the bond to be rated
- the deal was based on swap transactions directly between Swiss Re (who reinsured Matsui) and capital market players rather than via a special purpose vehicle, and was therefore quicker to place and easier to market. Swiss Re pay a fixed return to investors who in turn pay a floating rate, which depends on the incidence of an earthquake.

27.3 The use of an identical trigger is the first example of the development of an “off-the-shelf” securitisation structure.

28 Appendix F – Reliance National (deals 2 and 3)

Introduction

28.1 Reliance National Insurance Co. is a major US-based property insurer and reinsurer. They also have operations in Europe, South America and Asia Pacific.

28.2 In March 1997 they issued 18 month discounted zero coupon notes with a LIBOR based floating rate. In the event of any of the defined insurance losses occurring during the first twelve months of the term, part of the principal under the deal was to be lost. The classes of insurance risk covered under the deal were: US property; property ex-US; aviation; marine drilling rigs and satellite launch failure. Insured losses were measured by reference to the SIGMA loss indices. The advisor on the deal was Sedgwick and the notes were issued via a Special Purpose Vehicle – SLF Reinsurance in Barbados.

28.3 In April 1998 Reliance National issued an equivalent note of the same type.

28.4 In May 1998 they made a third issue based on the same risks and special purpose vehicle – however this issue was note an actual note but rather the option to issue such a note.

Structure

28.5 Reliance have purchased the right, but not obligation, to issue a note of the above type at any time during a three year period. When/if issued the note would pay a rate of LIBOR plus 837.5 basis points semi-annually and would be exposed for the remainder of the term until the end of the calendar year 2000.

28.6 For the standby option facility Reliance is paying a rate of 150 basis points per year (for up to three years).

28.7 Whenever it is issued the note is not exposed to the first two eligible events after the start of the option period (not the date when the option is exercised).

Analysis

28.8 This deal is believed to be the first to utilise such an option structure and combines some of the techniques of catastrophe bonds with those of contingent capital facilities.

28.9 The particular advantage for Reliance is that it gives them the option to secure a form of reinsurance coverage at guaranteed prices in the event of the reinsurance market hardening, particularly after two major events.

29 Appendix G – US Automobile Association

Introduction

29.1 USAA is a major US personal lines insurer.

29.2 In June 1997 they issued $477M of catastrophe bonds, following an unsuccessful offer in 1996. This bond covered USAA for one year for 80% of a loss caused by a single hurricane of Category 3, 4 or 5 on the Saffir-Simpson index of hurricane intensities resulting in insured property damage losses of between $1 billion and $1.5 billion to USAA policyholders in the East Coast areas from Texas to Maine.

29.3 In June 1998, on the expiry of the risk period of the first bond, USAA issued another bond.

29.4 The 1998 offer was much more competitively priced than the capital at risk element of the 1997 deal – a spread of around 400 basis points over LIBOR compared to 576 basis points previously.

29.5 The cover was for $450M (compared to $400M in the previous offer).

29.6 Note also that in 1997 Goldman Sachs completed a further deal where a reinsurer who felt that their own exposure to East Coast Hurricane closely matched that of USAA purchased a protection of $35m based on a swap transaction indexed to the Residential Re cover.

30 Appendix H – Yasuda

Introduction

30.1 Yasuda is Japan's second largest property and casualty reinsurer.

Structure

30.2 Yasuda reinsured typhoon risks with Munich Re who have in turn retroceded 95% of the risk to Pacific Re Ltd – a Cayman Islands based special purpose reinsurer established by Midland Bank (both Yasuda and Munich Re took a 5% retention of the transferred risks).

30.3 Pacific Re has in turn issued $80M of bonds paying 370 points over LIBOR with an initial maturity of 5 years (see below). Capital of these bonds (which are rated BB-/Ba3) is entirely at risk. The reinsurance coverage is for

- a typhoon loss with more than 165bn Yen gross loss to Yasuda or
- a typhoon loss with greater than 80bn Yen loss (this is called a "drop-down" event) followed by another Typhoon of similar magnitude

30.4 Note that the trigger points are altered, based on exposure modelling to maintain the same probability of loss (0.94% and 3.35% probabilities respectively).

30.5 Following a drop-down event, the bond pays a coupon of LIBOR plus 950 basis points. In the event of a drop-down event in the fourth of fifth years, the life of the bond is extended to six or seven years respectively.

30.6 The deal was structured and placed by Aon Capital Markets, and loss modelling was carried out by RMS using their IRAS Japan Typhoon Model.

Analysis

30.7 As well as "fronting" the transaction so that Yasuda have the benefit of a conventional reinsurance contract, Munich Re provided risk participation (to give additional comfort to investors) and will provide loss adjustment and verification services (as well as "closing-out" any outstanding liabilities at the end of the bond period).

30.8 For Yasuda the deal provides them with additional reinsurance capacity plus stability in reinsurance costs, particularly following a first typhoon

31 Appendix I –Client of Paribas

Introduction

31.1 In July 1998, Alternative Risk Finance (a specialised subsidiary established by Axa Insurance group and the Paribas bank) placed a catastrophe option on behalf of one of Paribas's American clients, to protect against Californian earthquake risk.

31.2 The option was placed with a small number of mainly European investors.

Structure

31.3 Investors in the option received an option premium, if, when the option is exercised, a major earthquake has taken place with insured losses greater than the strike price of the option, investors are required to pay a % of the excess to Paribas.

Analysis

31.4 This is a new structure within insurance securitisation – and is a combination of insurance bond and insurance derivative structures.

31.5 Use of an option rather than the more traditional bond structure meant that the investors did not have to commit capital up front and also speeded up the process.

32 Appendix J - F&G Re

32.1 F&G Re (a subsidiary of St Paul Re) issued a catastrophe bond for around $50M protection lined to their catastrophe reinsurance book.

32.2 The bond was marketed by Goldman Sachs and EW Blanch and was issued via a special purpose vehicle – Mosaic Re established in the Cayman Islands.

32.3 Pricing was believed to be in the range 550-575 basis points over LIBOR reflecting the high probability of the underlying reinsurance layer being breached, compared to other recent transactions.