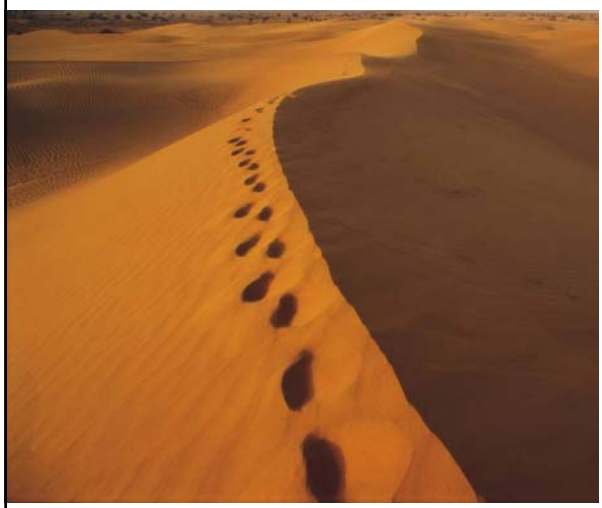

# Risk Based Management and Asset Liability Management for Insurance (Session 1)

Presented to the Society of Actuaries of Indonesia

Luke Seberry (F.I.A.A.)
April 2007

## Introduction

Seminar split into 6 sessions:-

| | First | Second |
|---|---|---|
| Day 1 | 1. Definition and Development of RBM/ERM | 2. Asset Liability Management |
| Day 2 | 3. Stochastic Modeling | 4. Economic Capital Analysis |
| Day 3 | 5. Risk Control Planning | 6. Summary and Recommendations |

Please note Sessions 3 and 4 are heavily focused on mathematical concepts.

## Session 1 - Definition and Development of RBM/ERM

Risk Management comes under many names, but the concept is the same. The term Enterprise Risk Management has become the most common term used in Actuarial circles, so this term, or ERM, is used in this presentation for consistency.

## What is ERM?

Enterprise Risk Management is a philosophy of how to make decisions for and manage an enterprise, allowing for all the various risks the enterprise faces.

In its "Overview of Enterprise Risk Management," the Casualty Actuarial Society describes Enterprise Risk Management as:

"… the discipline by which an organization in any industry assesses, controls, exploits, finances and monitors risk from all sources for the purposes of increasing the organization's short- and long-term value to its stakeholders."

ERM relates to any enterprise, company or organization, not just insurance companies.

For insurance companies, this is what underwriters and actuaries have been doing for years. Or what they should have been doing.

## Risk Control Process

A company implementing ERM would establish a risk control process, including steps such as:

1. Identify risks
2. Evaluate risks
3. Monitor risks
4. Risk limits
5. Risk avoidance
6. Offsetting risk
7. Transfer risks

(This is taken loosely from the Enterprise Risk Management Specialty Guide issued by the Society of Actuaries)

## Risk Control Process - Identify Risks

1. Identify Risks

ERM applies to any type or enterprise. As an example, an insurance company could consider the following:

- Interest rate risk
- Currency risk
- Pricing risk
- Credit risk
- Equity market risk
- Liquidity risk
- Operational risk

Different types of companies or enterprises would have different types of risk, but the concept is the same.

## Risk Control Process - Evaluate Risks

Each risk is given a priority depending on frequency and possible magnitude of losses that could arise.

For instance an operational risk is that an earthquake could damage a company's headquarters, disrupting operations. While the magnitude of loss would be quite large, the expected frequency of such occurrences (in most locations) is so small that overall the risk would be given a low priority.

As part of the evaluation process, risks could be split into quantifiable and non-quantifiable, with mathematical techniques used to evaluate the quantifiable risks and what-if scenarios used to evaluate the non-quantifiable risks.

## What risks are non-quantifiable?

In theory all risks can be quantified. However for those with a very low likelihood of occurring, it would be very hard to determine the probability and expected magnitude of loss.

Some non-quantifiable risks

- Risk of management fraud
- Impact of resignation of key staff
- Impact on operations of an epidemic

Some quantifiable risks

- Interest rate risk
- Risk of reinsurer default
- Impact on total claims payments of an epidemic

Quantifiable risks are discussed in sessions 2, 3 and 4. Non-quantifiable risks are discussed further in session 5.

## Risk Control Process - Monitor Risks

Continually gather internal and external information on this type of risk.

A mining company may have an operational risk related to how frequently a particular type of drill breaks down, including the cost of repair and the cost of lost operations. Monitoring internal data could show that different levels of maintenance lead to different frequencies of breakdown. Industry and vendor data could suggest different maintenance techniques, and statistics for different drills with different characteristics.

## Risk Control Process - Risk Limits

Determine what levels of risk are acceptable to be retained, and action plans to deal with excess risk.

For a life insurance company the combined claims due to a natural disaster could be quite large, and insurers take out catastrophe reinsurance to cover this.

For a large industrial company, the company may be willing to retain some level of fire, but may have a limit beyond which the risk is insured. Thus the company would buy a fire insurance policy with a deductible.

## Risk Control Process - Risk Avoidance

Eliminate the possibility of occurrence for some risks.

For example

- Product design could be changed to avoid underwriting exposure to health insurance risks
- Change cash handling procedures to reduce fraud risk

## Risk Control Process - Offsetting Risk

Undertake activities or contracts which are impacted by the same risk, but in the opposite direction.

A car manufacturer would have currency risk with relation to the costs of materials, and also to sales revenue. By writing contracts for materials and sales in the same currency, the net impact of movements in currencies can be minimised.

## Risk Control Process - Transferring risks

Transfer the risk to another party.

For a bookstore there would be the risk of making a loss on stocking books by unknown authors. To counter this, the bookstore would have a contract with the publisher such that for some categories of books, if the books were not sold after a certain period they would be returned to the publisher. In this way the risk of slow sales for these books is transferred away from the bookstore.

## ERM in Summary

ERM Summary

- ERM is a process, a method for dealing with risks
- Focus of ERM is creating value, not reducing risk
- ERM does not just relate to insurance companies
- Risk Management has been around for a long time

Some companies have been applying the risk management techniques described above for a long time. The emphasis on ERM is that ALL companies need to apply these techniques, to ALL types of risks.

## Proximate Drivers of ERM

Proximate causes underlying the development of ERM:-

1. Company collapses and accounting scandals
2. Public and political pressure to limit future collapses and scandals
3. Investigations by regulators and resulting recommendations

## Ultimate Drivers of ERM

Ultimate causes underlying the development of ERM:-

1. Faster computers

Previously risk management considered individual risks, but it was very difficult to combine these risks to look at the impact on an enterprise as a whole. Now financial modeling and statistical techniques can be used that were not available previously.

2. Internet and other media

Companies now have access to data and research on best practices from around the world. Furthermore, investors and the public also have access to this information, putting pressure on regulators and senior management of enterprises to implement these best practices.

## Regulatory and Market Developments

Some drivers of change for ERM

- Basel
- COSO
- Cadbury report
- Dey report
- Turnbull report
- Sarbanes-Oxley Act
- Rating agencies

## Basel

- Basel Committee on Banking Supervision formed 1974.
- Members include central bank governors and regulators from major industrialised countries.
- In 1988 the 'Basel Capital Accord' was reached, setting forth a new framework for minimum risk-based capital requirements for internationally active banks.
- Has been adopted by more than 100 countries.
- Various revisions leading to 'Basel II' accord in 2004.

Capital is risk sensitive, depending on weightings of different assets classes, and also takes into account a bank's internal systems and management.

## COSO

- In 1985, The Committee of Sponsoring Organisations (all of the main U.S. accounting bodies) formed an independent commission to study the factors that allow fraudulent financial reporting.
- A foundation of ERM methodology is COSO's 1992 'Internal Control - Integrated Framework'. This publication formulated a uniform approach to managing internal control systems.
- In 2004 the COSO's Treadway Commission (led by PricewaterhouseCoopers), issued a report 'Enterprise Risk Management - Integrated Framework'. This report outlines suggested procedures and controls for managing risk at an Enterprise level.

## Cadbury report

- In 1992 the Cadbury Committee published its report on 'The Financial Aspects of Corporate Governance'. This included a Code of Best Practice.
- The report included suggestions on the structure and responsibilities of company boards, and the use of auditors.
- The Code included the requirement that the directors report on the effectiveness of the company's system of internal control.
- In 1992 the London Stock Exchange introduced new regulations based on the Cadbury Committee's Code of Best Practice.

## Dey Report

- In 1994, the Toronto Stock Exchange issued a paper 'Where were the Directors?' (the Dey Report) on corporate governance in Canada.
- The recommendations included were approved by the Ontario Securities Commission. These recommendations have subsequently been used to shape corporate governance regulations in the U.S. and in Europe.
- Item number 2 on the specific list of responsibilities that are part of a board's overall responsibilities, titled 'Managing Risk' states:- 'The board must understand the principle risks of all aspects of the business in which the corporation is engaged, and recognizing that business decisions require the incurrence of risk achieve a proper balance between the risks incurred and the potential return to shareholders. This requires the board to ensure that there are systems in place which effectively monitor and manage these risks withy a view to the long term viability of the corporation.'
- A report by the Toronto Stock Exchange 5 years later found that 39% of companies had still had no formal process, rising to 55% in the gold and precious minerals sector.

## Turnbull Report

- In 1999 the Financial Reporting Council (UK) issued 'Internal Control: Guidance for Director's on the Combined Code'.
- This guidance is required to be followed for companies listed on the London Stock Exchange
- The guidance contains the requirement that the board is responsible for the company's system of internal control, and that it should consider
  - the nature and extent of the risks facing the company;
  - the extent and categories of risk which it regards as acceptable for the company to bear;
  - the likelihood of the risks concerned materialising;
  - the company's ability to reduce the incidence and impact on the business of risks that do materialise; and
  - the costs of operating particular controls relative to the benefit thereby obtained in managing the related risks.
- Notably there is no detailed prescription as to how to implement the guidance.
- The revised guidance issued in 2005 noted that while some companies saw these requirements as an added regulatory reporting burden, companies that derived the most benefit from application of the guidance were those whose boards saw embedded risk management and internal control as an integral part of running the business.

## Sarbanes-Oxley Act

- Enacted in 2002 after collapse of Enron and Worldcom.
- Included risk management processes aimed to keep internal controls up to date.
- One key provision requires SEC registered companies to evaluate the effectiveness of internal controls over information issued in the capital markets and have such evaluation audited and made public.
- Implementing the rules is considered costly and time consuming by many companies. Where foreign companies have de-listed from U.S. stock exchanges, and emerging companies have listed in other exchanges rather than the U.S., one of the reasons cited is the cost of complying with Sarbanes-Oxley.
- Commentators have stated that even if the Sarbanes-Oxley requirements were in force at the time, it would not have brought to light the problems entrenched at Enron and Worldcom.

## Rating Agencies

- Rating agencies have always considered a company's ability to manage risks.
- In the early 1990's implemented the concept of risk-adjusted view of capital and earnings.
- Actively consider a company's Economic Capital methodology and ERM process in setting ratings.
- Will consider whether ERM is integrated into company processes, or only taken into account at senior management levels.
- A company that understands and can actively discuss the various risks may receive better ratings.

## Other Regulators and Agencies

ERM is now quite in vogue. A sample of other regulators and agencies issuing guidance in this area:

- International Association of Insurance Regulators
- Committee of European and Insurance and Occupational Pensions Supervisors
- Australian Prudential Regulation Authority
- Monetary Authority of Singapore
- Institute of Risk Management (UK)
- Council of Standards Australia/Council of Standards New Zealand

## Real life examples of benefits of ERM

- A seller of Variable Annuity business in the U.S. realised in 2002 that it was vulnerable to a drop in the stock market, and put a hedge in place in June 2002. By December 2002 the market had declined considerably, and the company realised the hedge for a gain of US$200 million. This offset losses due to the variable annuity business.
- In 2004 a company in Asia realised that it was exposed to losses if local interest rates fell. At that time U.S. interest rates were very low and there was an expectation that U.S. rates would rise at some stage in the near future, and that local interest rates would rise as well. It was considered very unlikely that local interest rates would fall, yet a hedge was put in place. Over the next few months local interest rates fell, and the company was able to realise a gain on the hedge of several million U.S. dollars.

## Summary

- Enterprise Risk Management is a philosophy of how to make decisions for and manage an enterprise, allowing for all the various risks the enterprise faces.
- ERM does not just relate to insurance companies
- Various regulatory bodies have dealt with risk management, with different levels of compulsory regulations and voluntary guidance in different countries.
- While ERM is a good discipline for company management, it is also considered by markets and rating agencies.

## End of Session 1

Seminar split into 6 sessions:-

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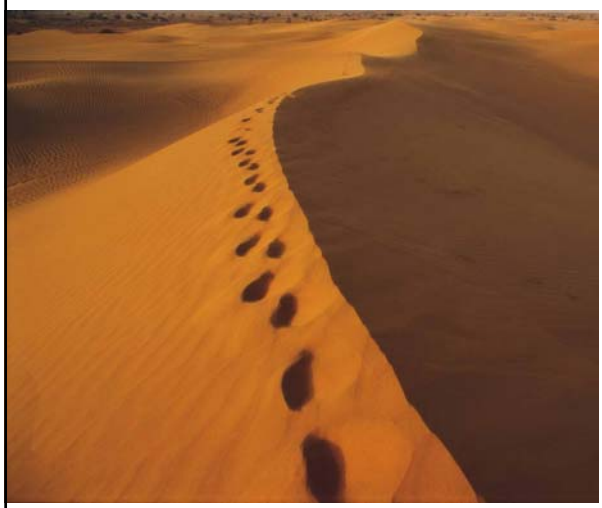

# Risk Based Management and Asset Liability Management for Insurance (Session 2)

Presented to the Society of Actuaries of Indonesia

Luke Seberry (F.I.A.A.)
April 2007

## Introduction

Seminar split into 6 sessions:-

| | First | Second |
|---|---|---|
| Day 1 | 1. Definition and Development of RBM/ERM | 2. Asset Liability Management |
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## Session 2 - Asset Liability Management

What is ALM?

Asset Liability Matching?
Asset Liability Modeling?
Asset Liability Management?
Asset Liability Mis-Management?

## Liability Modeling

First cash flow models in insurance were used to determine appropriate levels of commissions. In theory commissions could be set in proportion to the profitability of the product to the company, so that it would not matter which products an agent chose to sell.

Cash flow modeling developed first with pricing, and later with valuations.

## Liability models

Typically include the following variables and cash flows (and more)

| | |
|---|---|
| Mortality | Premium |
| Morbidity | Commission |
| Interest Rate | Expenses |
| Commission Rate | Claims |
| Initial Expenses | Interest |
| Renewal Expenses | Tax |
| Lapse rates | Profit |
| Reserving basis | Transfer |
| Capital requirements | |
| Tax rates | |

## Pricing decision criteria

- In traditional pricing procedures, items such as interest rate were fixed for all durations, and expenses were fixed regardless of expected sales volume.
- Historically, the pricing criteria was that a certain IRR had to be achieved on transfers. As new product types were sold, including investment linked products (also called variable universal life), which did not require as much capital, criteria such as profit margins were introduced.
- The minimum target may have been an IRR of 15% or a profit margin of 5% at a discount rate of 10%. These may indicate that in both cases the insurer wanted a 10% return on capital, and added a bit extra to allow for uncertainty.
- Scenario testing was also performed, to make sure that profit was still positive under adverse scenarios. Scenarios were typically chosen without considering the probability that the scenario would occur. (Is this a bad thing?)
- Traditionally, adding a bit extra, in profit criteria, padding of assumptions, and scenario testing, was necessary as it was difficult to measure the risks involved.

## Suggested decision criteria

- With advances in computing power, other criteria can be considered as well. However, many actuaries in many countries have not kept up, and only consider IRR and profit margin.
- Allow for actual systems and management expense. This is done by calculating total amounts, in P&L fashion, instead of percentages or amounts per policy. This can show whether the assumed level of initial or renewal expenses is reasonable.
- Allow for reduction in sales of other products, or lapses of current business. There will always be churning of products, but where a new product is better than an old one, then agents could be expected to convert policies to the new product. The way to perform the analysis is to determine the difference in the Appraisal Value for the company under the old and new scenarios.
- Another common error is to calculate profit margins for different ages, but not for the portfolio as a whole. With modern computing power there is no reason not to use a detailed portfolio breakdown in determining overall profitability.

## Valuations

Some valuation methods also rely on cash flow modeling

- Gross Premium valuation (GPV). Realistic or best estimate valuation.
- Fair Value of Liabilities (as per IFRS). Best estimate plus PAD.
- Embedded Value (EV). Value of a company's net assets and in-force business, not allowing for future new business.
- Appraisal Value (AV). Actuarial value of a company, allowing for net assets, in-force and future new business.

EV could be calculated using a flat interest rate, but EV and AV usually allow for asset modeling.

## Asset Modeling

- Traditional approach. Consider each asset class, determine percentage in each, combine for total model.
- Should returns be assumed constant over time? Economists typically build short term models, and try to predict the movements over, say, 1 year. Actuaries typically build long term models, and ignore data which can indicate short term movements. One approach is to have different assumptions for the short term and longer term.
- Should the percentage in each asset class remain the same over time? When modeling liabilities with a limited life span (such as GPV or EV), it makes sense to change the asset allocation.

## Some asset classes

- Cash
- Bonds
- Equities
- Property
- Other

These can be local or international.

Cash is normally overnight up to 3-month government paper.

## Bonds

- Government and Corporate
- Traditionally, actuarial models have ignored the probability of default of corporate bonds.
- Spread between government and corporate is assumed constant. Currently spreads are lower than historically.
- (In some countries corporate bonds have a negative spread. How is this explained?)
- Traditionally, bond class was modeled with an assumed return per year, like an interest rate. Actual modeling of bonds with coupon payments shows a very different outcome when yields are assumed to change over time.
- Some bonds are convertible or have special conditions. This can materially impact the results.

## Bond modeling example

Real life example: Testing was performed to see the impact of a change in the yield curve. A different yield will impact the market value of a bond, however the model used required the Market Value for each bond and the overall market yield to be entered separately. At the time, the user only changed the market yield and not the price, making these become inconsistent and the results invalid.

Original scenario

| | |
|---|---|
| Government bond 10-year yield | 3.5% |
| Assumed corporate spread | 0.5% |
| Corporate bond 10-year yield | 4.0% |
| Price 10-year zero-coupon bond | $67.56 |

Test scenario

| | |
|---|---|
| Government bond 10-year yield | 3.0% |
| Price 10-year zero-coupon bond | $67.56 (price entered by user) |
| Model assumes corporate spread | 1.0% |

Correct method is to either set bond price to $70.89 (for 3.5%), or use the original scenario for month zero, and change to lower interest rate at month one, allowing the model to calculate the new price.

It does not matter how good the model is if it is used incorrectly.

## Equities

- Paper by Kurz (97) suggests a 'normalised' equity risk premium of 5.5% above long term government bonds, for all countries.
- U.S. Dow Jones index averaged 7% over 100 year period.
- These ignore recent information. If equities have risen dramatically in one year, is the expected yield for the next year lower?

## Property and Others

Direct property and non-listed REITs have liquidity risks. How to model these?

Listed REITs similar to equities, return a bit lower.

Other assets include:

- Policy loans. Can be 10% of asset portfolio in some companies, so cannot be ignored.
- Mortgages (depending on country). Normally treated as cash + x%, with default risk. However mortgages can be repaid early depending on economic conditions.

## Efficient Market Hypothesis

- To model future asset values, we need to estimate future returns. How can we do this?
- Developed in the 60s, EMH assumes that market prices already allow for all price sensitive information. Semi-Strong Form allows for all public information, and Strong Form assumes even private information is already allowed for.
- Under EMH, past data and trends could be used to help estimate future trends. The logic is that the market was efficient in the past and will remain so.
- Then why does equity consistently give better returns? There is risk and the price allows for risk, but the returns appear too high for the level of risk. This is the Equity Premium Paradox.

## Behavioural Finance

Behavioural Finance allows that decisions may not always be made on a purely economic rational basis.

- Prospect Theory. A potential small loss is given more weight than a potential large gain. This is reasonable if we consider an example of a bet that could give a profit of $101 or a loss of $100 with equal probability. A person with a million dollars would take the bet, but a person with only $101 dollars in total assets might decline. Prospect theory explains why people take out insurance. It also can explain the Equity Premium Paradox.
- Loss Aversion. A person may continue to hold on to an asset which has lost value rather than sell it and incur a realised loss.
- Hyperbolic discounting. People may unconsciously require a much higher return for the short term than the longer term. For instance an investor may be willing to invest in a 1-year CD at 10%, but balk at an investment that offered 1% in one week.

## Behavioural Finance (cont.)

- Heuristics. People use a rule of thumb in many situations. This are based on past experience of what has worked. However the current situation could be quite different from the past situations, and rule is still applied.

- Framing. The words used to state a problem can change the approach taken. Imagine a country where shops cannot open on Sunday. You are going to conduct a telephone poll to see if people want Sunday shopping. Which question will get more Yes votes?

  - Should shops open on Sunday, to allow busy families to buy necessities at a time convenient to them?
  - Should shops open on Sunday, so that greedy shopowners can continue to squeeze more profits from the public?

## Behavioural Finance (cont.)

- Price Reaction to Information, whereby when new information is received a process of Underreaction, Adjustment, Overreaction occurs, can explain trends in prices. Also Herding, where individuals think that others may have more information than them, can also explain trends.
- In August 1997 the FTSE index in the UK hit 5000. Fundamental analysis showed this was too high by historic standards. The right plan is to cash out right? The index dropped below 3300 in March 2003.
- In December 2000 the index rose to above 6900. Anyone who cashed out years earlier would have been considered to have made a grave mistake.
- Status Quo Bias. In the early 1990s the U.S. states of New Jersey and Pennsylvania had similar programs of tort law reform. Citizens were offered two options for their automotive insurance: an expensive option giving them full right to sue and a less expensive option with restricted rights to sue. Corresponding options in each state were roughly equivalent. In New Jersey the more expensive option was the default and 75% of citizens selected it, while only 20% chose this option in Pennsylvania where the other option was the default.

## Behavioural Finance (cont.)

- Iniquity Aversion. Suppose you see a person cheat and make money. Then you have an opportunity to make $1, but if make this decision then the cheat will also make a further $100. Some people would choose to make a small loss in order to punish another person who has acted unfairly.
- Behavioural Life Cycle Hypothesis. People view their assets as belonging to Current Income, Current Wealth and Future Income, and it is very hard mentally to reassign an asset to a different category. This is why people with credit card debt may continue to hold investment assets rather sell them to pay off the debt.

How can an actuary estimate future returns knowing that the market can act irrationally? If possible the actuary would want to protect his portfolio by choosing a strategy that is safe under different future scenarios.

## ALM Theory

- Redington (52), 'proves' that a portfolio of known liabilities can be immunized by setting up a portfolio of assets with the same duration but greater convexity (achieved by greater spread of durations).
- For instance, if a company has a liability of $162.89 payable in 10 years, and the 10-year interest rate is 5%, then the PV of the liability is $100. Investing $100 in 10 year bonds is the simplest solution.
- However if no 10 year bonds are available, only 5 year and 15 year bonds then what can be done?

## ALM Theory (cont.)

- By investing in the 5 and 15 year bonds, the company is immunized against interest rate movements. If interest rates go down, the value of the liabilities will go up, and the value of assets will go up a bit more. If interest rates go up, the value of the liabilities will go down, and the value of assets will go down a bit less.

| Class | Term | Face | 5% | 4% | 6% |
|---|---|---|---|---|---|
| A | 5 | 63.81 | 50.00 | 52.45 | 47.68 |
| A | 15 | 103.95 | 50.00 | 57.75 | 43.37 |
| L | 10 | 162.89 | 100.00 | 110.04 | 90.96 |
| A-L | | | 0.00 | 0.16 | 0.09 |

- However, this assumes that interest rate movements are of the same amount at all durations. If short and long interest rates move by different amounts, the result can be quite different.

- This is not to say that duration matching is a bad idea. If tested carefully it can be very useful.

## Dedicated Portfolio

An even stronger form of immunization is dedication. This is where a portfolio of bonds is chosen to exactly match the durations of all of the liability cashflows.

Real life examples

– A company had a portfolio of endowments, and calculated the durations of liability cashflows, and then asked an investment manager to match this. The company actuary sent regular emails showing the latest estimates and timing of the future cashflows. However, the manager in charge of the fund never received the emails, as they were sent to the wrong person.

– An investment manager was given the duration of a portfolio of liabilities on a regular basis, about 30 years. However, at that time (2004) interest rates were expected to rise, and investing in 30-year bonds would lead to losses if interest rates rose. The manager was paid a bonus according to the return on the fund, not on the difference between the return and an index of 30-year bond returns. The manager had no incentive to match the duration.

## Currency hedge example

Real life example

- The Local subsidiary of a U.S. company was measured on fixed exchange rate of $L(local) to $US, as it was considered unfair that the local management should be impacted by changes in something they couldn't control (the exchange rate).
- The subsidiary had liabilities in $L. At that time interest rates in $US were higher than $L. The subsidiary bought some US$ bonds.
- The subsidiary wanted to hedge against a rise in $L, as this would lower the value of $US bonds in $L terms.
- Head office was really interested in $US profit. They did not hedge as were willing to take the currency risk. If they had wanted to create a hedge, they would have wanted to hedge against fall in $L.
- Of course the subsidiary should have hedged with the head office.

## Stress Testing

Companies use scenario testing to see what happens in adverse situations.

- NY7 is a set of scenarios to see the impact on solvency of changes to interest rates, introduced by the New York Department of Insurance in the U.S.
- Singapore has introduced Stress Testing, requiring cashflow projections for 5 years on sets of different scenarios.

The Singapore example is a good idea. It could be improved by:-

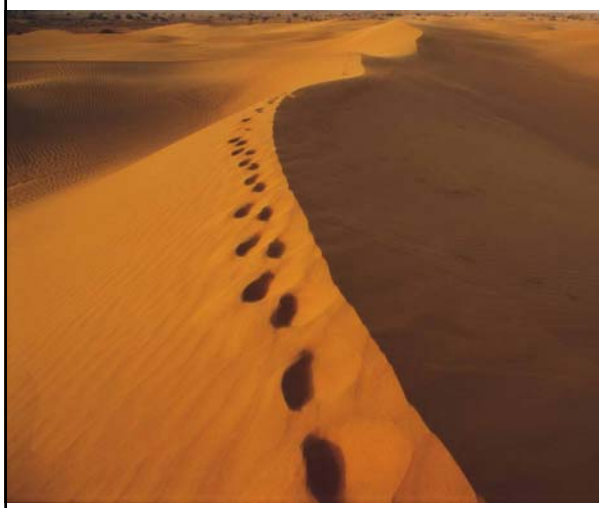
- Prescribing more of the scenarios. Currently, aside from the base scenario, only 2 scenarios are prescribed, and the insurer chooses 4 more. An insurer is unlikely to report scenarios that show insolvency or weak results.
- One scenario requires testing of reduced interest rates. However, given the asset portfolio of many companies, this will increase the value of bonds and likely make the reported results stronger. A better result would be achieved by requiring different scenarios for both a reduction and an increase in rates.

However, if the main idea is to force the insurer to go through a scenario testing exercise, even if the relevant results are not reported, at least the company management has a better understanding of the company's financial position.

## Limitations of Stress Testing

- Cannot determine magnitude of risk, probability of loss
- Cannot determine optimum or efficient portfolio of assets
- Cannot measure cost of options or guarantees
- Cannot measure dynamic impact on liabilities. For example, do lapse rates change if interest rates change, and what is the impact on liabilities?

These require stochastic modeling.



# Risk Based Management and Asset Liability Management for Insurance (Session 3)

Presented to the Society of Actuaries of Indonesia

Luke Seberry (F.I.A.A.)
April 2007

## Introduction

Seminar split into 6 sessions:-

| | First | Second |
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## Session 3 - Stochastic Modeling

What it is. What it isn't.

- Value at Risk is a banking concept. Given the combined various exposures of the bank, how much could be lost in one day due to market movements with a 1 in 1000 probability? 1 in 10000?
- Stochastic ALM for Life insurers. Considers random movements of assets, but typically does not allow for any random movement of liabilities.
- Dynamic Financial Analysis. Analysis of future General Insurer results, allowing for movements in assets and in liabilities.

What is the historic development?

## Financial Economics

Financial Economics is a specialty of Economics, primarily looking at the trade off between money now and money in the future, or with transactions where money of one type or another is likely to appear on both sides of a trade.

Financial Economics is a theoretical field, and many of the results and methods have been adopted by bankers, actuaries, and others dealing with the practical application of financial transactions. In many instances the methods have to be modified due to differences between the theoretical model and the real world.

## Modern Portfolio Theory & CAPM

Markowitz (52) theorised that an 'efficient frontier' of equity portfolios could be determined, giving the best expected return for a given level of risk. Tobin (58) went on to theorise that given two asset classes, equities and risk-free treasury notes, there is only one optimal portfolio of stocks, the 'market portfolio', as the efficient frontier of Markowitz is replaced by a 'Capital Market Line' which is made up of portfolios with different levels of treasuries and the market portfolio'.

Sharpe (64), had a further idea that the volatility of a stock's return can be split into a part that is not correlated to the market and part that is, and that the non-correlated parts can be diversified to zero in a large portfolio. Combined with the ideas above, this led to the Capital Asset Pricing Model (CAPM), which shows that the expected return on an equity in the market portfolio could be given by

$$E(Ri) = Rf + Bi * (E(Rm) - Rf)$$

where
Rf = risk free rate
Bi = the sensitivity of the asset returns to market returns
E(Rm) = the expected return on the market portfolio

Following on from the ideas of the Efficient Market Hypothesis and the concept of no-arbitrage, the prices of all equities would move to meet the expected return.

## Does CAPM Work?

Analysis was performed to show that the CAPM was valid. Results showed that riskier assets gave a higher return as would be expected.

Later analysis of the same data showed that the results were invalid. If a stock moves in price from $100 at time zero to $125 at time one and then $100 at time two, is the average return (25% - 20%) / 2 = 2.5% or ($100 - $100) / (2 * $100) = 0%?

Arguing that the model is a one period model, or that amounts invested are re-calibrated after each period, would allow the first result.

Yet how is volatility measured? By seeing the movements in prices in the same stocks over time.

## Black Scholes Option Pricing Model

Black and Scholes (73) derived formulas for valuing European put and call options. The formula for a European call option is

$p = s^* \Phi(d1) - x * e^{(-rt)} * \Phi(d2)$

where

$d1 = (\log(s/x) + (r+\sigma^2/2)*t) / (\sigma * \sqrt{t})$

$d2 = d1 - \sigma * \sqrt{t}$

and

s = the current price of the stock

x = the strike price

r = the continuously compounded risk free interest rate

t = the time in years until the expiration of the option

$\sigma$ = the implied volatility for the underlying stock

$\Phi$ = the standard normal cumulative distribution function

## Black Scholes Model (cont.)

The Black Scholes formulas, and others derived by similar methods, are widely used in industry.

The formulas rely on many assumptions:

- Continuous price movements. In reality a stock price could jump from $80 to $81 without ever touching $80.50.
- Stock price movements are normally distributed.

The derivation is based on the value of an underlying portfolio of two assets, the stock and treasuries, which matches the value of the call option. As the price of the stock moves, the percentages in the two assets would change. As the stock price rises the percentage of the portfolio invested in the stock would rise.

This underlying portfolio strategy implies that a way to reduce risk is to buy when prices are going up, and sell when prices are going down. This means that buying low and selling high is a risky strategy?

## Financial Economics in Practice

Assuming a normal distribution of stock price movements leads to convenient mathematical treatment and elegant solutions. Theoretical papers allowing for skewness and kurtosis of movements get very messy.

Thus while CAPM, Black-Scholes, and other theories are useful teaching tools, (and are actively used by some investors), the serious players such as investment banks develop their own in-house proprietary models.

Some practical developments in modeling, which are publicly available, relate to modeling of bonds and equities.

## Practical Bond Models

Important concepts for stochastic interest rate models are

- arbitrage free
- rates consistent for different durations
- no negative interest rates
- yet must allow for inverse or partly inverse yield curves

A stochastic model to meet these criteria could take an enormous amount of computing power. Considerable work has gone into developing practical models for different situations.

## Equity models

To allow for skewness and kurtosis of price movements, one idea is to use a regime switching model. For instance regime 1 could be low volatility positive growth, and regime 2 high volatility negative growth. An example is:

| | Regime 1 | Regime 2 |
|---|---|---|
| Expected Growth (annual) | 10% | -10% |
| Volatility (annual) | 5% | 20% |
| Probability of switch (quarterly) | 5% | 25% |

This sort of model can more accurately match historical patterns of volatility, while being straight-forward to implement.

## Wilkie Model

A more convincing model is one that allows for the interaction of interest rates and equity prices, and other economic variables. This concept was developed by Wilkie (86).

The Wilkie model

- uses Inflation as a base, calculated based on prior period Inflation and a random factor
- equity dividend rates are based on Inflation, prior period dividend rates, and a random factor
- interest rates are based on Inflation and a random factor

This is a one way dependency model, in that inflation impacts equities and interest rates. More recent studies have developed models allowing for more variables, and for the inflation rate to be impacted by prior period dividend and interest rates.

## Real Life Stochastic Modeling Example

This example relates to the implementation of stochastic modeling for an Investment Account (Universal Life) product in Taiwan. While some of the items are Taiwan specific and may not be relevant to Indonesia, this example shows the level of intricacy and detail that should be considered before implementing stochastic modeling.

The product was such that after paying an initial 2% fee, the policyholder would receive interest on his account balance and could cash in the policy at any time with no surrender penalty. No other fees were payable during the life of the policy.

The questions asked of the modeling were:

- What assets should be used to back the product?
- Management made decisions on crediting rates for marketing reasons. What is the impact on profits of in-force book using different levels of crediting rates?

Did not ask if new sales are profitable or if product should continue to be open for sale.

## Simple liability model

The process is to build a simple model, then make gradual adjustments to allow for various factors.

The initial model required asset returns, crediting rates, lapses, expense rates and other variables to be set by the user.

This model could be used to measure the impact of different levels of spread between interest rates and crediting rates, and different lapse rates. The model calculated monthly movements and cashflows

This raises the question of dynamic lapse rates. If the crediting rate drops compared to interest earned (or other external measures), will lapse rates rise and by how much?

Note that expenses were set, and the impact of different expense levels was not measured in the whole process. We assumed that the level of expenses was not relevant to the purposes of the model. For instance if the task is to decide whether to use asset mix A or B, the level of expenses does not make a significant impact.

## Deterministic Asset Model

The next step is a model of the various assets, and how these interact. Core asset classes were considered first.

- Equity - Shown as an index per month or a monthly return
- Bonds - A yield curve is entered or calculated for each month, with bond prices determined from these. Corporate bond spreads are then added on top, and these spreads can vary over time. Bond buy-backs and other provisions were ignored.
- US Equity and US Bonds - similar to above. At the time $US bonds gave yields 2-3% higher than Taiwan dollar bonds. Exchange rate also had to be allowed for in the formulas.

So far these parameters had to be entered or calculated by the user.

## Allow Impact of Management Decisions

How management set crediting rates had an unexpected impact on cashflows.

In Taiwan the 2-year CD rate (the average 2-year cash deposit rate offered to the public by 4 of the major banks) is used as a benchmark for insurance companies.

Management had decided to set the crediting rate equal to the CD Rate + 2%. The rate was determined each month, so management potentially set a new crediting rate every month. Management viewed its decision making as whether to maintain the spread at 2%, or shift to a different level.

However the CD rate did not have a perfect correlation with the bond yield curve. It was necessary to model the CD rate. Our analysis showed that the rate was not well correlated to the 2-year bond yield, but closer to the 90-day cash yield, roughly the 90-day yield + 0.70% over time.

Another complication in the model is that the crediting rate for any one policy was set once per year. This means for a policy commencing in August 2003, the August 2003 crediting rate would be used for one year. At August 2004 a new crediting rate would be set for that policy, with crediting rates set in between irrelevant for that individual policy.

The impact on the model was that the CD rate and crediting rates are now calculated by formula, based on the bond yield curve and a few parameters.

## Other Asset Classes

After an initial analysis of the suitability of the core asset classes, an examination was made of other assets owned by the company.

Policy loans - Interest rates fixed at policy commencement. Interest rate was typically 2% higher than current crediting rates. Loan termination rates, where a policyholder pays off the whole loan in one go instead of over time, need to be factored in.

Mortgages - Interest rates were again related to the 2-year CD rate. Typically the interest rate for each mortgage was reset every 6 months, based on a formula of CD + x%. Many loans gave preferential rates for the first years, so the rate may be CD + a% in year 1, CD + b% in year 2, CD + c% thereafter. Again, loan termination rates need to be factored in.

Analysis showed that mortgages gave the best matching to liabilities of all asset classes. Policy Loans were also useful, giving a much higher return than any available bonds.

## Dynamic Lapses & Loan Terminations

Do lapse rates change with different interest rates? To properly test the impact of management decisions on crediting rates this question needs to be considered. If 2-year CD rates move closer or further from 2-year bond rates, will this affect lapses as investors have other choices? In the end we chose to allow lapse rates to change based only on the spread of crediting rates to CD. Considering the lack of data, any choice that seems logical can be considered reasonable.

To estimate the change in lapse rates, the methods available are to to consider US data (based on products and an economy which are quite different), or by interviews with management and sales staff.

Policy Loan termination rates may change if interest rates on personal loans available in the market change.

Mortgage Loan termination rates may change based on the economy. In a poor economy there may be more defaults. If interest rates go up there may be more terminations to avoid higher interest charges.

To properly determine which assets are most suitable, and the actual exposure to interest rate movements, these various factors need to be allowed for.

## Stochastic asset model

By this stage the model has been set up to allow user input of interest rates and other parameters relating to assets, and to allow these to vary over time.

These parameters can be chosen by the user as scenario tests, or calculated stochastically. We used a combination of both.

For equities, we required expected returns, and volatility of returns. For bonds, using current yield curves as a base, we required volatilities of movements and correlations between movements for different durations.

Further, we needed to determine correlations between movements in equities and bonds, and between movements in yield curves in Taiwan and the U.S. and the exchange rate.

Various analyses have been performed of U.S. equities and bonds, and models have been generated for use in stochastic simulations.

## Stochastic asset model (cont.)

We performed an analysis of historic data, and could not find a correlation between Taiwan equities and any other asset class, nor between U.S. and Taiwan yield curve movements, nor bond yields to the exchange rate. This does not say that there is no correlation, just that we could not find one.

In the end we estimated parameters for Taiwan equity and bond movements. And we decided to perform scenario testing on exchange rates, generating 3 sets of scenarios with steady, increasing and decreasing rates, rather than stochastic analysis.

Note that we did not model economic growth or inflation. As with exchange rates, this would just add another level of complexity, and more parameters that would be difficult to estimate.

From these various parameters, we could run stochastic models to generate multiple scenarios of different market conditions. These could then be entered into the model above to generate sets of cash flow results.

## End result

After the initial results, management cancelled the project.

The results showed that there was no combination of assets that made the product viable. It is unlikely that refining the model would have changed this view.

The company reduced crediting rates for existing policies, and put less emphasis on this product for future sales.

The company instead decided to develop structured note products, with the underlying investment guarantee provided by an investment bank.

## Lessons

In many cases, DST or scenario testing, or common sense, is more useful for most decision making. In this example, if banks are refusing to offer this type of product, is it really going to be worthwhile for an insurer? Banks tend to have a better understanding of asset liability management than insurers.

Options, guarantees need stochastic, no choice. Have to be modeled stochastically due to asymmetric return pattern.

Only model what needs to be modeled.

Very hard to estimate volatility variables. One method is to run the model for both high and low volatility. If the resulting decision is the same, then the exact value of the volatility is not important.

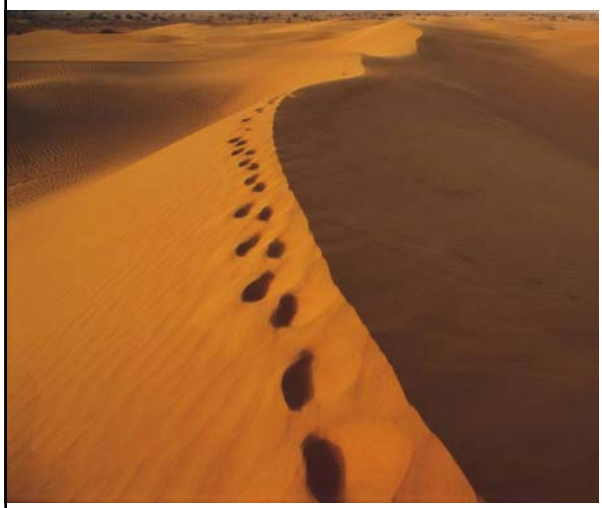
Stochastic testing can be useful to help the actuary understand the problem better. After generating the results, the actuary can focus on those scenarios which lead to losses. For instance, if scenarios with inverse yield curves lead to losses, then decisions can be made to limit exposure to this type of scenario.

## Lessons (cont.)

A stochastic model will need estimates of management and policyholder behaviour. Will lapse rates change under different scenarios? Will management change the asset allocation under different scenarios?

Long term projections are unreliable, especially with volatility. Should stochastic analysis consider the company position in one year, and not long term? The logic is that management will see the actual results and make further decisions at that time, so is it relevant to model stochastically beyond then?

Is there another way to model volatility and risk, and allow useful decision making? Economic capital.



# Risk Based Management and Asset Liability Management for Insurance (Session 4)

Presented to the Society of Actuaries of Indonesia

Luke Seberry (F.I.A.A.)
April 2007

## Introduction

Seminar split into 6 sessions:-

| | First | Second |
|---|---|---|
| Day 1 | 1. Definition and Development of RBM/ERM | 2. Asset Liability Management |
| Day 2 | 3. Stochastic Modeling | 4. Economic Capital Analysis |
| Day 3 | 5. Risk Control Planning | 6. Summary and Recommendations |

## Session 4 - Economic Capital Analysis

Economic Capital (EC) is a decision making tool. It provides a framework for making decisions allowing for the relative levels of risk and return of the scenario in question compared to the enterprise as a whole.

The idea of EC was developed for banks, and can be applied to any type of organisation or enterprise. However, so far the idea has only really caught on for banks and insurance companies.

The SOA Specialty Guide on Economic Capital uses a definition of "sufficient surplus to meet potential losses, at a given risk tolerance level, over a specified time horizon".

Different people have different ideas about what EC is, how it should be calculated and how it should be used. The outline in this presentation is my personal view of EC, and is not the only possible interpretation.

In practical terms, EC can be thought of as being similar to a solvency margin or RBC. Statutory RBC may be calculated with factors for a few risks, while EC allows for all risks that the enterprise faces. Further, Statutory RBC uses the same factors for all companies, whereas EC uses factors based on the risk profile of that company, with different amounts for each risk retained, and with “riskier” risks requiring more EC. The decision making process is then to calculate how much EC is required, and the Net Present Value of EC adjusted cashflows or the rate of return that can be achieved on the EC.

Why use EC?

## Risk Tolerance

It is possible to state the company's risk tolerance in mathematical terms. Some possible quantifications of risk tolerance:

- Minimise the probability that each product line will make a loss over the fiscal year.
- Maximise the embedded value of the insurance company, however allowing for at most a 0.5% risk of insolvency over the next 5 years.
- Maximise the expected after tax profitability of the conglomerate to which the insurance company belongs over the fiscal year, allowing for at most a 5% risk of making a loss in any one quarter.

## How do you link Risk Tolerance to Decision Making?

One possible approach

1. Build a projection model for the entire company
2. Estimate the mean and volatility of each parameter underlying the model
3. For every decision the company makes, runs a full stochastic model before and after the decision

A simplification

1. Build a projection model for the entire company
2. Estimate the mean and volatility of each parameter underlying the model
3. Calculate the Impact on results changing each parameter by one standard deviation
4. Assume impact of each variable is normally distributed, most are independent and some are correlated, estimate correlation factors, and calculate aggregate volatility
5. For each decision re-run model before and after

## What is the best approach?

Re-running a full company model, especially a stochastic model, for every decision could be a bit time consuming.

A common approach to ERM is to use EC.

Typically a detailed EC study is performed annually, allowing for each of the various risks a company is subject to (with estimates for non-quantifiable ones). Total EC for the company is determined, and EC is apportioned back to individual risks or products.

When EC is used for monthly reporting or in decision making, factors and estimates would be used to come up with updated figures for EC. If new risks are added (and the volatility is small compared to the overall risk), then the EC for these new risks can just be estimated in proportion to volatility.

If a new product is proposed to be launched, the profit margin would be calculated allowing for EC, and if the return on capital is high enough then the product would go ahead. A riskier product would require a higher level of EC, and thus a higher level of profitability on the underlying product would be required to achieve the same return on capital.

## Calculating EC

One approach is to calculate an amount of volatility for each of the various risks, and then a combined volatility for the whole company allowing for correlations. Then total EC would be calculated by looking at the risk tolerance requirements. EC can then be apportioned back to individual risks or products in proportion to the volatility for that risk or product.

Another approach is to work out the stand-alone EC for each risk first, assuming the risk tolerance requirement applies to each risk. These are then combined, allowing for correlations, to obtain the total EC. The total EC is then apportioned back to the individual risks, allowing for the diversification benefit.

Yet another approach is to use scenario testing. An overall scenario (or multiple different scenarios) is determined which equates to the risk tolerance level, with the change in surplus compared to the base scenario being the EC. However volatilities for each risk would still be needed to apportion the EC.

There are many different approaches currently in use.

## EC individual risks

A Health Insurer looking at its hospital admission rates might consider:

- Pricing risk. Is the assumed admission rate at the correct level for the overall population?
- Claims volatility. Statistical fluctuation due to the insured portfolio being smaller than the overall population.
- Catastrophe risk.
- Increase over time. Where premiums are guaranteed for multiple years. Even if policy wordings allow for premium adjustment, the regulatory or consumer advocacy environment could make premium adjustments difficult, and this risk would still have to be considered.

These would be combined to determine the hospital admission rate volatility.

For surgical benefits, surgical incidence rate volatility could be considered as above, but there would also be claim size volatility to be considered. These would be combined to determine total surgical claims cost volatility.

## Correlation of Risks

The volatility of the various risks need to be combined to achieve an aggregate volatility.

To do this, the risks are assumed to have normal distributions, with variance used to measure the volatility. Correlation co-efficients are determined for each pair of risks, and the overall variance determined by remembering:

```
Var(A+B) = Var(A)
         + 2*corr(A,B)*√(Var(A)*Var(B))
         + Var(B)
```

With 20 or more risks, a risk correlation matrix will take some time to fill in. However most risks will be considered to be independent of each other.

## Total EC and EC per risk

The total EC is set in relation to the company's risk tolerance. For example if the risk tolerance has been stated as:

> Maximise profits allowing for at most 0.5% probability of insolvency over one year

then the required EC = 2.58 * Var (Profit) - Expected Profit

Note this this ignores regulatory solvency or RBC. If the risk tolerance is stated with regard to regulatory solvency then the EC calculation would be changed to allow for this.

Note that actual Net Asset Value could be more or less than the EC calculated. The EC is the amount of capital that should be held given the risk tolerance. For instance, if actual NAV is less than EC, then this indicates that capital should be injected or risky strategies or operations should be scaled down.

EC for any particular risk is then taken in proportion to the volatility for that risk compared to the total volatility.

## Decision making

While the initial process of determining EC for the whole company can take considerable effort, the benefit is that after this the decision evaluation process for various projects is then made easier.

Only the risks related to a particular project need to be considered in detail, as the other risks undertaken by the company are already allowed for in the EC. Decision making is then made using standard actuarial techniques, such as Net Present Value or Internal Rate of Return, where the project cashflows are adjusted to allow for the cost of capital.

## Example Outline

A small company sells one line of hospital business. With no regulatory solvency requirement, the company sets its risk tolerance as having at most a 5% chance of insolvency over 1 year.

Using the following assumptions

| | |
|---|---|
| Expenses (incl. commission) | 10% |
| Loss Ratio | 80% |
| Tax Rate | 26% |
| Standard deviation of claims | 30.5% of expected claims |
| No interest and other items ignored | |
| Required return on EC | 10% |

Reinsurance offered such that for a 3% premium, expected claims reduced by 1.25% (or 1% of premium), but claim volatility reduced by 60%.

Should the company write the product?

Should the company accept the reinsurance?

## Evaluation Methodology

Determine expected Net Profit and risk tolerance, then use these to calculate EC. From these the NPV can be determined for each scenario, with the higher the NPV the better.

| | |
|---|---|
| Gross Profit | = Premium - Expenses - Claims |
| Net Profit | = Gross Profit * (1 - Tax Rate) |
| Risk Tolerance | = Standard Deviation of Claims<br>* Probability Distribution Factor |
| EC | = (Risk Tolerance - Gross Profit) * (1 - Tax Rate) |
| NPV of business | = Start year expected transfer<br>+ End year expected transfer discounted for 1 year |

## Should the company write the business?

The expected results are

| | |
|---|---|
| Premium | $100 |
| Expenses (incl. commission) | $ 10 |
| Claims | $ 80 |
| Gross Profit | $ 10 |
| Net Profit | $ 7.40 |

Risk tolerance limit for claims = $80 * 30.5% * 1.64 = $40

Thus EC required = ($40 - $10) * (1 - 26%) = $22.20
(assuming tax losses can be fully utilised)

NPV of business = -$22.20 + ($22.20 + $7.40) / (1.1)
= $4.71

Yes, the company should write the business

## Should the company take the reinsurance?

The expected net of reinsurance results are

| | |
|---|---|
| Premium | $ 97 |
| Expenses (incl. commission) | $ 10 |
| Claims | $ 79 |
| Gross Profit | $ 8 |
| Net Profit | $ 5.92 |

Risk tolerance limit for net claims = $40 * 40% = $16

Thus EC required = ($16 - $8) * (1 - 26%) = $5.92
(assuming tax losses can be fully utilised)

NPV of business = -$5.92 + ($5.92 + $5.92) / (1.1)
= $4.84

NPV for no reinsurance is $4.71 above, so yes, the company should take the reinsurance.

## Decision analysis for the local branch of a global company

Consider a global company which is diversified into multiple markets, and makes decisions based on overall results. This effectively means excess profits in some markets can be offset against losses in others.

Where results in different markets are independent or largely uncorrelated, the EC required is reduced. Allowing for an 80% reduction in required EC, then the 2 analyses above would become:

No reinsurance
EC = $22.20 * 20% = $4.44
NPV = -$4.44 + ($4.44 + $7.40) / (1.1) = $6.32

With reinsurance
EC = $5.92 * 20% = $1.18
NPV = -$1.18 + ($1.18 + $5.92) / (1.1) = $5.27

In this case the company would still write the business, but would forgo the reinsurance.

## Internal reinsurance

A global company could choose to reinsure the business, on the same terms as provided by the external reinsurer, but to another company within the group. This could make sense where the receiving country is in a different tax situation.

Many Japanese life insurers have recorded losses over the last several years and have large amounts of tax losses which cannot be used up. So in effect the business could be reinsured to the Japanese subsidiary and pay zero tax on the inwards reinsurance profits.

The expected combined net profit for the transaction is

| | Local | Japan | Total |
|---|---|---|---|
| Premium | $97 | $ 3 | $100 |
| Expenses (incl. commission) | $10 | $ 0.3 | $ 10.3 |
| Claims | $79 | $ 1 | $ 80 |
| Gross Profit | $ 8 | $ 1.7 | $ 9.7 |
| Net Profit | $ 5.92 | $ 1.7 | $ 7.62 |

(This scenario allows for higher total expenses considering the extra effort involved)

## Internal Reinsurance (cont.)

EC = Local EC + Japan EC
= $1.18 + ($24 - $1.7) * (1 - 0%) * 20%
= $5.64

NPV = -$5.64 + ($5.64 + $7.62) / (1.1)
= $6.41

This compares to an NPV of $6.32 for retaining all of the business locally, thus the company would choose to reinsure the business to the Japan subsidiary.

## Example conclusions

Consider the various scenarios

| | Local Company | | Global Company | | |
|---|---|---|---|---|---|
| | with Reins | w/o Reins | with Reins | w/o Reins | Reinsure Internally |
| Net Profit | $ 7.40 | $ 5.92 | $ 7.40 | $ 5.92 | $ 7.62 |
| Tolerance | $40.00 | $16.00 | $40.00 | $16.00 | $40.00 |
| EC | $22.20 | $ 5.92 | $ 4.44 | $ 1.18 | $ 5.64 |
| NPV | $ 4.71 | $ 4.84 | $ 6.32 | $ 5.27 | $ 6.41 |

Results

(1) The company is better off writing the business than not.

(2) For a small company, or the local subsidiary of a global firm that evaluates the results of the subsidiary on a stand-alone basis, the company should take the reinsurance offered.

(3) For the local subsidiary of a global firm that evaluates its results on a combined basis, the company should retain the risk and not reinsure.

(4) Where the global firm has another subsidiary in a tax environment such that no tax is payable, the business should be reinsured internally within the group to that subsidiary.

## Simplifications in the example

In practice, various other items would be considered, even in analysing this simple example.

- Some quantifiable risks can be managed by both statistical and risk control methods. For instance, pricing risk is managed by underwriting and claims standards and also by EC methodology.
- ALM risk has been ignored, and for many product types tends to be significantly larger than the claims risk.
- Expense risk. For instance do total claim handling expenses move in proportion to claims paid? What if more investigations are made on claims leading to lower claims paid, but higher claims handling expenses?
- Reinsurer default risk. How should this be managed? For example, some companies handle this by only using reinsurers with a credit rating of AA or better.

## Closing ideas

More details in the SOA Guide. The Guide was a draft, and said that common practices were discussed, and that when the final version was released the best practices would be included. The draft Guide was released in 2004, 3 years later the final version is not ready. Does this mean there is no consensus on what the best practices are?

EC calculated by a company could be more or less than regulatory capital. In Asian countries and the U.S. EC is typically higher. In Europe it is typically lower, giving companies a concrete basis to discuss with regulators the possibility of reducing statutory capital requirements. Many companies will discuss their EC models with ratings agencies to try to achieve better ratings.

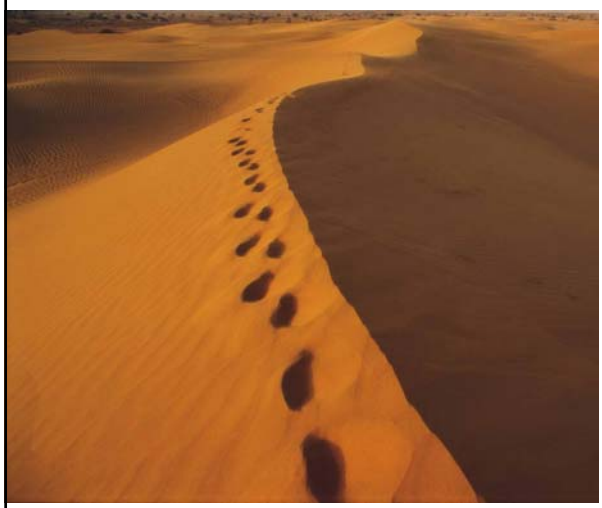
A company need not necessarily hold a level of actual surplus equal to the calculated EC. EC is typically calculated by a complex model with many estimates for various parameters. EC is best treated as a guide for helping to make decisions.

## Closing ideas (cont.)

This discussion has not focused on the Target Return on EC. A company hoping to achieve a 10% return on capital may currently use a pricing decision hurdle of an IRR of 15% or a profit margin of 5% at 10% discount rate. These calculations do not allow for the risks involved, and requiring a return greater than 10% is a way of compensating for taking on risk, even if the amount of risk is unknown.

A major benefit of determining EC is that undergoing the process leads to a better understanding of the various risks and their relative impact on the company.

EC is a common approach to dealing with quantifiable risks. What ERM methods are suitable for non-quantifiable risks? Risk Control Planning.



# Risk Based Management and Asset Liability Management for Insurance (Session 5)

Presented to the Society of Actuaries of Indonesia

Luke Seberry (F.I.A.A.)
April 2007

## Introduction

Seminar split into 6 sessions:-

| | First | Second |
|---|---|---|
| Day 1 | 1. Definition and Development of RBM/ERM | 2. Asset Liability Management |
| Day 2 | 3. Stochastic Modeling | 4. Economic Capital Analysis |
| Day 3 | 5. Risk Control Planning | 6. Summary and Recommendations |

## Session 5 - Risk Control Planning

Enterprise Risk Management is a philosophy of how to make decisions for and manage an enterprise, allowing for all the various risks the enterprise faces.

Economic Capital is a common approach to dealing with quantifiable risks. What ERM methods are suitable for non-quantifiable risks?

Risk Control Planning

- Crisis Planning
- Succession Planning
- What-if scenarios
- Business Continuity Plans
- Disaster recovery plans
- Document everyday business processes

Many of these plans already exist

## Risk Control Process

In session 1 we looked a the Risk Control Process.

1. Identify risks
2. Evaluate risks
3. Monitor risks
4. Risk limits
5. Risk avoidance
6. Offsetting risk
7. Transfer risks

Need to add one more step:

0. Decide who is going to look at risks

## Chief Risk Officer

Some companies, especially in the U.S., have created a new position called the Chief Risk Officer (CRO).

The CRO's main task is risk management. If the person looking after risk management has other job functions, it is likely that risk management will get low priority.

CRO is independent. If the CRO is also the CFO or Chief Actuary, there is a conflict of interest. In the past, and still ongoing in many companies, the Chief Actuary was unofficially also the main person looking after risk.

Does the CRO report to the Board/CEO, or is it a more junior position? Is the person chosen highly experienced and senior in the industry? Ratings agencies ask these types of questions.

## What type of risks?

Regular business processes

- Underwriting manuals
- Claims processes
- Back-up of computer networks and document filing

Underwriting questions and medical limits have been developed over time. It would be very hard to quantify the impact of one particular question or medical test.

When large claims are rejected clear reasons need to be given. If the case is taken to court or reported in the media the company needs to have a clear plan for who communicates to the press and how.

Why are ex-gratia claims made? Due to an unclear claims decision making process.

Why do you back up your network every week? Why are documents filed and stored?

## What type of risks ? (cont.)

Recent one-off major events

- Tsunami
- Riots
- Earthquake causing internet disruption

Other one-off events

- Succession planning. What happens on the loss of the CEO? Create a list of internal and external candidates. However, if the head of a major division is chosen as the CEO, is there also a plan for who is going to run that division? Many companies restrict the number of senior executives who can travel on the same flight.
- Y2K. All together, U.S. companies spent $100 billion preparing for Y2K. Companies in Italy spent $1 billion. No major event occurred in either country. Does this mean American companies planned poorly and spent too much?
- Which risks should be considered, and how should they be dealt with? Consider the regulators in various countries.

## Risk Management Plans from Regulators

NAIC (National Association of Insurance Commissioners (U.S.))
APRA (Australia Prudential Regulation Authority)
FSA (Financial Services Authority (UK))
MAS (Monetary Authority of Singapore)

These bodies have all issued guidelines and suggestions, as have many other countries.

Many of these guidelines are very vague.

One of the better ones is the "Business Continuity Management Practice Guide" by the FSA. It identifies 5 topics

- Corporate Continuity
- Corporate Crisis Management
- Corporate Systems
- Corporate Facilities
- Corporate People

## Corporate continuity

For a business continuity plan (BCP), the guide recommends considering

- How often risk assessments are carried out
- What the plan contains
- Who creates and owns the plan
- How the plan is communicated to staff
- Consulting with local emergency services providers
- Plans be subject to external audit
- Be tested at least every two years
- Include recovery times for critical functions

## Corporate Crisis Management

- Select a crisis management team which may be different from senior management
- Senior management give clear authority to team in time of crisis
- Team involved in testing of crisis plan
- Specified team activation
- Team assembly (physical place, by telephone)
- Crisis team has specified spending authority during crisis
- Plan covers communications to staff, media and other parties

## Corporate Systems

Systems Plan identifies

- Critical computer systems
- Consequences of allowing non-affected systems to continue when other are non-operational
- Process for recovering each system
- Recovery time for system
- Where mirror or back-up systems are used, consider how smooth the transfer is, and continuity when main systems are restored
- Systems and capabilities of telecoms and third party IT providers
- IT resilience. System recovery does not depend on one key person, or accessibility to one key location
- Security, encryption, firewalls and anti-virus software
- Systems protected from physical damage, such as power surges, fire, water
- Specific plans for telephone systems

## Corporate Facilities

- Planning. Specialist building manager involved in developing plan. If other tenants in the same building then joint planning.
- Energy. Allow for power surges or temporary loss of power.
- Water. Water supply is lost or becomes contaminated.
- Security. 24 hour security, CCTV. Magnetic cards. ID badges. Post room to receive items. Fire detection systems.
- Evacuation. Alarm system and evacuation points. Fire drills.
- Emergency Services. Keep them informed. Ask for help in developing plans.
- Testing. Test of evacuation, power supply, etc. on regular basis.

## Corporate People

- Staff awareness of the plan, and their role in a crisis
- Staff training
- Key staff restricted from traveling together
- Unique skills identified and cross trained to other staff
- Reference checks for new employees and contractors
- Background security checks for staff in key positions
- Checks are repeated, not just at commencement
- Plan to keep in contact with all staff during crisis recovery period
- Staff welfare, including medical care and counseling, researched and available

## Risk Management in Singapore

- Business Continuity Plans tend to be one-factor plans, allowing for the recovery from a particular disaster or crisis. However when a crisis occurs, there could be any number of secondary events which can only be studied by looking into the ultimate cause or event.
- A regulator providing this kind of stronger risk management guidance is the Monetary Authority of Singapore.
- Aside from Business Continuance, MAS in 2006 required all banks and insurance companies to develop plans based on specific scenarios, a Flu Pandemic and Terrorist Attack.

## Singapore Flu Pandemic Scenario

Aligned to Singapore Ministry of Health's Disease Outbreak Response System Condition flu alert levels. The MOH report contains scenarios at different levels regarding the expected impact of a Flu Pandemic, including expected numbers of people impacted.

Company's plans had to consider:

- Business continuity where a large number of staff have become sick
- Alternate work arrangements such as work from home or a secondary work site where there is risk of contagion
- Anticipate changes in customer behaviour, such as more use of ATM's, phone and internet service
- Insurers also considered the extra insurance claims that could arise

## Business Scenario Planning

There is no need to wait for regulators to first introduce requirements. Many companies have developed detailed Scenario Planning as part of the strategic planning process.

The Royal Dutch Shell group has led the commercial world in the use of scenarios, and the development of practical techniques to support these. Starting in 1971, the process was given impetus by the Oil Shocks of 1973. The company was also surprised by the growing awareness of Environmentalism and public opinion, and subsequently expanded the nature and range of scenarios considered.

As a result of this process, Shell was able to benefit considerably from later movements in oil prices, to the order of billions of dollars. Another successful gamble was opening up natural gas fields off Norway, by postulating the possible breakup of the U.S.S.R. and the opening of ex-soviet markets to external energy providers.

More recently the use of scenario planning has reduced considerably, as many company CEO's focus more and more on short term results.

## Practical use of Scenario Planning

There is no need to employ a large team of analysts dedicated full-time to scenario planning. While detailed planning can come up with detailed decision analysis, simple planning can usually create a few common sense suggestions.

For instance, most Indonesian firms have a crisis management plan in case of riot or civil commotion. For an insurance company, a detailed plan may estimate the expected amount of claim losses that may be incurred, a simple plan including communication between employees and securing the office from physical damage can be developed quite readily.

Similar plans could be made for a Flu Pandemic, along the lines of the Singapore suggestion, including plans for employees to work from home or to use a secondary office site to reduce the chances of contagion.

Below are some further scenarios that could be considered in a scenario planning analysis.

## Yen Carry Trade

The Carry Trade is where investors borrow money at very low interest rates, and invest in anything, such as equities or higher yielding bonds in other currencies. The main currency for borrowing is Yen, but Swiss Francs have also been used.

It is estimated that trillions of dollars have been borrowed in Yen, and that if the Yen were to appreciate, or Yen interest rates rise, then the closing of these positions would impact liquidity and markets throughout the world.

Recently, the Bank of Japan increased interest rates by 0.25% and share markets in Asia, notably in China, dropped by several percent. Possibly the China share markets did not drop for this reason, but consider

- stockmarkets throughout the world are overpriced according to historical PE analysis
- the spread between short-term US dollar CD's and 10-year bonds is historically low
- the spread between US dollar treasuries and corporate bonds is historically low

A scenario to consider is what if the Yen carry trade were to unwind suddenly? What impact would this have on exchange rates, interest rates and stockmarkets? While the economic fundamentals in Indonesia may not be impacted, is it likely that currency markets would consider fundamentals if a large selldown occurred across several markets?

## U.S. Mortgage Sub-prime rates

Sub-prime mortgages are loans given to people with poor credit histories to purchase residential property. Interest rates on these mortgages are higher than those for prime mortgages.

As the U.S. property market rose, owners were able to buy property with very little capital hoping that a few years later the increase in house prices would mean buyers had built up considerable equity in their homes. Banks and finance companies were able to build a large portfolio of loans, and built a large capacity to finance more loans.

As the property market faltered, banks had a large capacity to give out loans, but fewer prime borrowers. The interest rate spread between sub-prime and prime mortgages reduced to historically low levels.

What if the U.S. sub-prime mortgage market deteriorates? A further weakening in U.S. housing prices or a weakening in the economy could lead to mortgage defaults, leading to losses for some U.S. banks and finance companies, and an increase in spreads for mortgage backed securities. Would this lead to an increase in interest rates in Indonesia?

## Tokyo Earthquake

The Kobe earthquake on January 17, 1995, measuring 7.3 on the Richter scale, caused an estimated US$100 billion in property damage. What would happen if there was a major earthquake in Tokyo?

Initially there would be a large number of deaths and injuries, and substantial property damage, requiring payouts from insurers. Much of this would be passed on to reinsurers, pushing up reinsurance premium rates throughout the world.

A much greater impact would be the loss of productivity as companies would have to close or relocate operations. This would have a major impact on the Japanese economy, and on the world economy as business linked to Japan would be impacted.

What impact would this have on markets? After some disasters markets have recovered quite quickly, such as after the Kobe earthquake. Would this be the same for Tokyo?

## End to Iraq War

Some companies evaluate scenarios where there is an increase in hostilities in the middle East.

What would happen if there was a reduction in hostilities, and the U.S. removed most of its forces from the region?

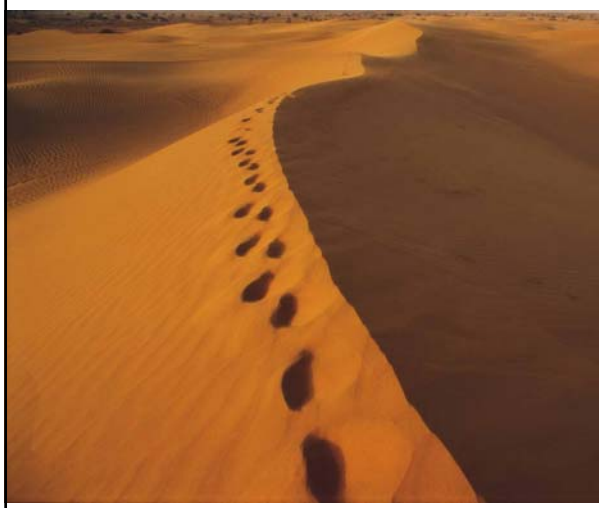
The U.S. currently spends hundreds of billions of dollars each year on the Iraq war. This has a huge impact on the U.S. current account deficit. If this were to reduce, the U.S. dollar might appreciate, alleviating pressure on the Chinese Yuan and other countries, and reduce the value of the Euro. Or the impact may be much smaller.

## Normalised Indonesian Economy

Currently Indonesian interest rates are higher than for other countries in the region, due to a perception of higher risk.

What would happen if the political situation stabilised, the economy improved, and Indonesia was considered to be a lower risk economy?

Possibly interest rates could fall and the currency appreciate. Currently some long term insurance business is written assuming that high interest rates will continue into the future; would companies writing this business be able to cope?



# Risk Based Management and Asset Liability Management for Insurance (Session 6)

Presented to the Society of Actuaries of Indonesia

Luke Seberry (F.I.A.A.)
April 2007

## Introduction

Seminar split into 6 sessions:-

| | First | Second |
|---|---|---|
| Day 1 | 1. Definition and Development of RBM/ERM | 2. Asset Liability Management |
| Day 2 | 3. Stochastic Modeling | 4. Economic Capital Analysis |
| Day 3 | 5. Risk Control Planning | 6. Summary and Recommendations |

## Session 6 - Summary and Recommendations

Summary of sessions 1 to 5

Two examples of risk management failure

Recommendations for actuaries

## Session 1 Summary

### Risk Control Process

Enterprise Risk Management is a philosophy of how to make decisions for and manage an enterprise, allowing for all the various risks the enterprise faces. ERM relates to any enterprise, company or organization, not just insurance companies.

A company implementing ERM would establish a risk control process, including steps such as:

1. Identify risks
2. Evaluate risks
3. Monitor risks
4. Risk limits
5. Risk avoidance
6. Offsetting risk
7. Transfer risks

## Session 1 Summary (cont.)

### Regulatory and Market Developments

- Basel (banking RBC)
- COSO (US - internal control systems)
- Cadbury report (UK - board report on controls)
- Dey report (Canada - board understand risks)
- Turnbull report (UK - board consider all risks)
- Sarbanes-Oxley Act (US - effectiveness internal controls)
- Rating agencies

## Session 2 Summary

### Asset Liability Management

• Need to understand liabilities. Start with liability modeling.

• Liability modeling for pricing.

• Pricing decision criteria.
  - IRR
  - Profit Margin
  - Model product P/L
  - Model company P/L
  - Common errors in pricing. Not consider actual portfolio weighting.

• Liability modeling for valuation.

## Session 2 Summary (cont.)

### Financial models

- Efficient Market Hypothesis
- Behavioural Finance
- Duration Matching and Immunization

### Stress Testing

- New York 7
- Dynamic Stress Testing
- Singapore requirements

## Session 2 Summary (cont.)

### Simple asset modeling

Which asset classes?

Common model errors:

- Bond interest rate against price.
- Equities given extremely high yields

## Session 3 Summary

### Stochastic Modeling

• Uses of stochastic modeling
• VAR (banks)
• ALM (life insurers)
• DFA (non-life insurers)

### Financial economics

• CAPM
• Black-Scholes
• Useful teaching tools, but serious players create proprietary models

## Session 3 Summary (cont.)

### Some practical ideas

- Interest rate models
- Equity models with regime switching
- Wilkie model

### Lessons

- In many cases simpler models more useful results.
- Options, guarantees need stochastic, no choice. Have to be modeled stochastically due to asymmetric return pattern.
- Very hard to estimate volatility variables
- Just building a model can be useful, allowing for better understanding of the issues
- To be complete, stochastic model needs to model behaviour of management and policyholders

## Session 4 Summary

## Economic Capital Analysis

EC is similar to RBC or statutory solvency. EC is based on the actual risks undertaken by the enterprise, not factors set by the regulator.

Using the risk tolerance level, EC can be estimated for the entire enterprise. This can then be apportioned back to an amount of EC for each risk or product line.

Decision making using EC will allow for all of the risks undertaken by the enterprise, with the relative level of risk for the decision in question (such as product pricing) compared to other risks allowed for.

EC is best done on an enterprise level, not just for the company or product line.

A major benefit of determining EC is that undergoing the process leads to a better understanding of the various risks and their relative impact on the company.

## Session 5 Summary

## Risk Control Planning

Non-quantifiable risks are best managed by contingency and scenario planning. Sometimes this is the best way to manage quantifiable risks as well.

Some U.S. companies have developed the position of Chief Risk Officer. This role is independent of the actuarial and finance functions, and considers all risks facing the enterprise.

Many regulators have developed guidance for business continuance plans. These tend to expect one-factor plans, allowing for the impact of one isolated crisis, or one symptom of a crisis.

Singapore (and some other regulators) have gone further to request scenario planning, based on considering all of the impacts of the underlying event, rather than only considering the external impacts.

Some companies (Royal Dutch Shell) have used detailed scenario planning for strategic advantage. This has become less prominent recently as companies focus more and more on short term results.

## Risk Management Lapses - Barings Banks

Baring's Bank collapsed in 1995 with almost GBP 1 billion in losses. While some might attribute this to one rogue trader, in fact the management of the bank was incompetent in its risk management.

Following a reorganization in 1993, a matrix reporting system was introduced, with reporting by product and by operations. This left one key trader in Singapore with no clear manager to monitor day to day activities.

By effectively giving front and back office control to one person, losses in speculative trades could be kept secret.

- The valuation for the particular futures arbitrage contracts used includes a factor for volatility. By using an inflated volatility factor, the value of particular open contracts can appear to be very large, so large that the apparent unrealised gains are greater than the realised losses.
- By performing trades across separate accounts, profits were attributed to company accounts which were monitored regularly, and losses attributed to a dummy account.

## Risk Management Lapses - Barings Banks (cont.)

However, there were signs that should have been obvious that something was wrong.

• By February 1995, Barings had half the interest in the Nikkei future and 85% of the interest in the JGB future. Having such a large position in any market should be a concern.

• In a famous 1993 quote, Peter Baring, Chairman of Barings, commented to Brian Quinn, Director of the Bank of England that:

"The recovery in profitability has been amazing following the reorganization, leaving Barings to conclude that it was not actually terribly difficult to make money in the securities markets."

If you are making profits and you don't know why, isn't this a concern?

## Risk Management Lapses - LTCM

The hedge fund Long Term Capital Management collapsed in 1998, with US$4 billion in losses. With an army of PhD's and rocket scientists, and with two Nobel Economics prize winners among its partners, what went wrong?

LTCM had devised a "market-neutral" arbitrage system, that would make money in rising or falling markets. In three years the fund had nearly tripled its investors money by betting that spreads on similar investments that had always narrowed over time would continue to do so.

LTCM had devised several strategies, which all collapsed at the same time.

- Borrowing rubles from Russian banks and investing in Russian treasuries paying a higher interest rate seemed a safe bet. There was no currency risk, the interest rate risk was locked in, no problem. Until the Russian government defaulted.
- The financial crisis that ensued caused liquidity to dry up around the world, as cash was move to lower risk assets. Spreads between other similar investments were already at historically high levels. By betting that the spreads would decrease, when spreads actually increased further many hedge funds lost money. LTCM had bet so much on this strategy, that the movement ate up nearly all its capital.

## Risk Management Lapses – LTCM (cont.)

It has been speculated that if LTCM had had enough capital, when markets returned to normal levels the losses would have been canceled out.

LTCM had allowed for worst-case scenarios in its modeling, but it has been estimated that the worst-case that they modeled was only 60% of the level of losses that actually occurred.

## Recommendations for Actuaries

1. Follow the ideas behind Enterprise Risk Management. These means considering every risk that the company is subject to, and finding a way to manage the risk.

Even without a full team of analysts, simple DST and scenario planning should be carried out, even if these are not required by the regulator. For detailed scenarios, PAI could develop samples including values for assumptions and parameters, as small companies may not have the resources.

If hiring a full time CRO and risk management department would be prohibitively expensive for a small company, progress can be made by taking steps such as seeking an external advisor or non-executive director who has expertise in risk management.

## Recommendations for Actuaries (cont.)

2. For products with investment or other guarantees, such as investment linked (VUL) products with maturity guarantees or lifetime annuities

- analyse the nature of the risk
- investigate the level of risk using stochastic and scenario testing methods
- where the risk is too large to be kept in-house, transfer it using hedging, reinsurance, etc.
- where risk transfer is not available, or suitable analysis cannot be carried out, avoid the risk by not selling this type or product

## Recommendations for Actuaries (cont.)

3. Consider removing minimum valuation basis

- This will happen anyway with IFRS
- It is possible that some actuaries use this basis without analysing or understanding the true nature of the portfolio. Removing the minimum will force actuaries to understand the portfolio and justify the assumptions used.
- PAI can collect voluntary (or compulsory) samples of valuation assumptions and justifications. Some actuaries at smaller companies may not have the resources to research every aspect of valuation assumptions. However if assumptions are taken from this collected data, the actuary would still have to justify them.

## Recommendations for Actuaries (cont.)

4. Consider increasing RBC requirements, but allow lower levels for those companies that can justify them.

- RBC levels set for large and small companies. It is possible that larger companies could have less, smaller companies should have more.
- Larger companies can spend time to develop EC models, smaller companies may not have resources.
- Can smaller companies survive a shock to investment markets? Many companies survived 1997 financial crisis, but have lessons been learned?
- Under IFRS the concept of RBC will have to be reviewed anyway.
- Before implementation of IFRS, Bank Negara Malaysia is encouraging smaller insurance companies to merge. Australia has had consolidation of the insurance industry, with number of life insurers dropping from 50 to 30.

## Conclusion

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# Thank You