MANAGING RISK IN THE NEW WORLD – POST FINANCIAL CRISIS
- KEY LESSONS FOR ACTUARIES

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Chief Pricing Actuary, Life Asia
ICA 2010 – “UNITED IN OUR DIVERSITY”

- 1’500 delegates
- representing over 100 countries
- ca 100 sessions over 5 days with well over 250 speakers from 35 countries

renowned keynote speakers including:

- Pravin Gordhan (SA Finance Minister)
- Yoshihiro Kawai (secretary-general of the International Association of Insurance Supervisors)
- Paul Embrechts (Distinguished ETH Zurich Professor)

www.ica2010.com
Actuarial Profession at the Forefront of Risk Management

Boffins advise you to plan ahead for next crunch

Things went horribly wrong to cause the credit crisis, delegates at this week’s actuarial congress reminded us, and they’ll go wrong again. All you can do is be prepared, writes Bruce Cameron.

Do your homework to counter the effects of another crisis, the probability of which is 100%!
AGENDA: 10 Key Lessons of the GFC
was mainly a banking crisis but important lessons for actuaries...

The Scream of the Banker...
with apologies to Edvard Munch
Lesson #1: **Monitor the Market Environment** prior to the GFC...

**FINANCIAL CRISIS**

- **REGULATION** – outdated or missing
- **GLOBAL IMBALANCES** – major capital flows
- **INDUSTRY STRUCTURE** – complexity & interdependencies
- **ACCOUNTING RULES** – lack of transparency/disclosure
- **TECHNOLOGICAL ADVANCES** – supporting complex instruments
Lesson #2: **Track the Trends** prior to the GFC...
**Lesson #3: Crumbling of Capital During a Crisis**

and the need for more robust solvency & risk management...

Insurance sector capitalization (Accounting view)

- Reduction in primary insurers capital
  - 2007: [Bar graph showing capital reduction]
  - 2008 est.: [Bar graph showing capital reduction]

- Shareholders’ equity of reinsurers is declining for the first time in years (year-end US$ bn)
  - 2003: 300
  - 2004: 250
  - 2005: 200
  - 2006: 150
  - 2007: 100
  - 2008: -21%

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Main reasons for worsened capital situation of insurers:

- Realized and unrealized investment losses (responsible for ca. 90% of the capital reduction)
- Hurricanes Ike and Gustav (responsible for around 10% of the decline)
- Even more dramatic on an economic capital basis

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1. Aon Benfield estimate and Munich Re research, based on a sample of large global insurers w/o AIG
2. Munich Re. Data 2003–07 based on financial reports of 35 global reinsurance companies (incl. some primary insurance business); 2008 estimate based on external assessments of the biggest 15 companies as at February 2009; development influenced by exchange rate effects.
Lesson #3: **Crumbling of Capital During a Crisis**

Options to improve capital position:

**Assets:**
- Reduce Required Capital: De-risk

**Liabilities:**
- Reduce Required Capital: De-risk
- Reduce Liabilities

**Potentials:**
- Re-allocations within investment portfolios
  - Sale of participations
  - Reduction of equity ratio

- Reduce business volume
  - Reduction of, or exit capital intensive lines of business

- Restructure products & their management
  - Reduce product &/or mismatch risk, hedge

- Risk transfer mechanisms
  - Reinsurance

- Increase Capital
  - Increase equity, hybrids, subordinated debt
  - Increase income
    - Reinsurance
    - Sale of blocks/companies
    - Reduce sales of high strain business

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Reduction of capital requirements / Increase available capital:
Lesson #4: **Consider Credit Risk**
actuaries need to become more familiar with…

- Increased credit risk during GFC reflected in widening of corporate spreads & higher CDS rates
- CDS more dynamic versus Ratings
- Credit risk is systemic
- Need to understand legal framework & in particular bankruptcy procedures
- Pricing & valuations of insurance contracts need to consider:
  - default probabilities into cashflows
  - credit value at risk in capital amounts
  - shock lapses scenarios
- CDS market became very large & was unregulated
- Importance of underwriting credit risk…

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**EUR corporate spreads (10 years)**

**In the Shadow of an Unregulated Market**

The value of the credit default insurance market is now much larger than the domestic stock market, mortgage securities market and United States Treasuries market.

**In the Shadow of an Unregulated Market**

Sources: Thomson Proprietary Research, International Swaps and Derivatives Association
# APPENDIX: Credit Risk References

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<th>Credit Risk Identification</th>
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<td>Receivables</td>
<td>default probabilities</td>
<td>due diligence and aggregate counter-party exposure limits.</td>
</tr>
</tbody>
</table>

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- **Crouhy, Galai, & Mark, Risk Management, 2001**
  - Ch. 7, Credit Rating Systems
  - Ch. 8, Credit Migration Approach to Measuring Credit Risk
  - Ch. 9, The Contingent Claim Approach to Measuring Credit Risk
  - Ch. 10, Other Approaches: The Actuarial and Reduced-Form Approaches to Measuring Credit Risk
  - Ch. 12, Hedging Credit Risk
- **Tilman, Asset/Liability Management of Financial Institutions, 2003 - Ch. 9, “Measuring and Marking**
- **CSFB Credit Portfolio Modeling Handbook – Ch. 2, "The Default No Default World and Factor Models"**
- **CSFB Credit Portfolio Modeling Handbook – Ch. 9 “Risk measures: how long is a risky piece of string?"**
- **Fitch: Role and Function of Rating Agencies in the Operation of Securities**
- **US Senate: Financial Oversight of Enron: The SEC and Private-Sector Watchdogs (pp. 97-127 only)**
- **C. Smithson, Credit Portfolio Management - Ch. 1, The Revolution in Credit – Capital Is the Key**
Lesson #5: Lack of Liquidity During a Crisis

distinct from risk to capital adequacy…

- Liquidity risk is measure of probability that company’s cash resources will be insufficient to meet current or future cash needs.
- Valuable capital assets can become illiquid. Hence holding sufficient capital does not guarantee liquidity.
- During the GFC liquidity disappeared on most assets – cash became king.
- Liquidity risk of insurers is fundamentally different from that of banks – due to long term funding; surrender penalties, etc.
- Liquidity risk management to rely on scenario testing.
- Run on the bank type scenarios can occur…
## APPENDIX: Liquidity Risk References

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<th>Liquidity Risk Identification</th>
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<td>Forced selling &amp; margin calls</td>
<td>Stress testing</td>
<td>sizing of liquid versus illiquid positions</td>
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<td>Inability to satisfy liabilities</td>
<td>Scenario analysis</td>
<td>cash flow management</td>
</tr>
<tr>
<td>cashflow strain run on the bank hidden callable options</td>
<td>liquidity ratios; scenarios; etc.</td>
<td>diversification surrender charges contract design</td>
</tr>
</tbody>
</table>

### AFE References

- **Green**: General American Life Can't Pay Investors, Looks at Suitors
- **CIA**: “Liquidity Risk Measurement,” CIA Educational Note
- **Brunnermeier**: Deciphering the Liquidity and Credit Crunch
- **SoA**: Dynamic Financial Condition Analysis Handbook, Ch. 1 (background only), 8 and Appendix A
Lesson #6: Sensitized to Systemic Risk
do insurance companies pose systemic risk?

Containing systemic risk is at the core of the reforms contemplated for the financial services industry in the wake of the financial crisis – however, the question is: Do insurance companies pose systemic risk?

Pro

- **Size** of insurance industry: Euro-zone investments by insurers total €6 trillion (end of 2009)
- Strong **interconnectedness** with the banking sector due to insurers' holding of 10% of debt securities issued by Euro-area banks
- For European **bancassurance** companies spill-over effect can be direct and immediate
- **Economic** function of insurance industry: The industry facilitates financial and political stability

Con

- **Insolvencies** due to the crisis: just one insurance company, but more than 140 banks in the USA alone (however, failures of insurers can take years to emerge)
- **Business models** of banks and insurance companies differ significantly
- Because of **steady premium income**, insurers are less liable to liquidity risks
- No strong **interdependencies** among insurers, unlike the interbank trading of the banking sector
- Historically, **no ripple effect** to the sector even when large insurers failed
Lesson #6: Sensitized to Systemic Risk
also relevant for the insurance industry...

- Not a well-defined concept. Broadly defined as the risk of an event that would cause the collapse of a market or financial system (as opposed to the collapse of a single entity)

- Recent regulatory focus due to financial crisis

- Systemic risk lower compared to banking - fewer counterparties, nature of risks different; etc.

- But could emerge in:
  - credit or market risks
  - insurance risks - pandemics, catastrophes, longevity risk

- Risk management:
  - non-systemic risk – handled through diversification & risk capital
  - systemic risk – e.g. VA’s – handled through matching, hedging & securitization
Lesson #7: **Beware of the Black Swans**

still many unknowns…

- Black Swans – the “unknown unknowns”
- **Data risk** – is the past a good guide to the future – very relevant to actuaries
- Understand difference between risk & uncertainty
- The (6) **Mistakes** Executives Make in Risk Management (*Taleb, et al*):
  1. we think we can manage risk by predicting extreme events – need to **insure/hedge** against them
  2. we are convinced that studying the past will help us manage risk – predicting major changes is difficult; etc.
- Risk management techniques are relatively **new** & we’re still learning…look for **signs**…

The by now famous, distinction in Knight’s work between:

- **Risk**: randomness with **knowable** probabilities, and
- **Uncertainty**: randomness with **unknowable** probabilities

Ref: Embrechts ICA 2010

Frank H. Knight, 1921
Lesson #8: Careful of Contagion & Tail Correlation

many interdependencies...

- When risks are **uncorrelated**, sufficient diversification drives volatility towards zero
- When risks are **correlated**, no amount of diversification will eliminate risk
- In Life Insurance - deaths are fairly **uncorrelated**
- Business risks are usually **correlated** e.g. credit risk is systemic
- Interdependency & correlation of risks is complicated – especially in the tail e.g. credit & market risk
- Can use sophisticated techniques like **Copulas** to model some of the non-linear dependencies – but still have modeling risk

Ref: Embrechts ICA 2010

The Financial Times:

**Of couples and copulas** by Sam Jones (April 24, 2009)

In the autumn of 1987, the man who would become the world’s most influential actuary landed in Canada on a flight from China. He could apply the broken hearts maths to broken companies. Li, it seemed, had found the final piece of a risk management jigsaw that banks had been slowly piecing together since quants arrived on Wall Street.

$$\Pr[T_A < 1, T_B < 1] = \Phi_2(\Phi^{-1}(F_A(1)), \Phi^{-1}(F_B(1)), \gamma)$$
Lesson #9: Mindful of Financial Models

over-reliance on models - need to apply common sense & judgement...

The Turner Review
A regulatory response to the
global banking crisis
March 2009, FSA, London (126 pages)

1.1 (iv) Misplaced reliance on sophisticated maths

There are, however, fundamental questions about
The validity of VAR as a measure of risk (see Section
1.4 (ii) below). And the use of VAR measures based
on relatively short periods of historical observation
(e.g. 12 months) introduced dangerous procyclicality into the assessment of trading-book risk for the reasons set out in Box 1A (deficiencies of VAR).

The very complexity of the mathematics used to measure and manage risk, moreover, made it increasingly difficult for top management and boards to assess and exercise judgement over the risks being taken. Mathematical sophistication ended up not containing risk, but providing false assurance that other prima facie indicators of increasing risk (e.g. rapid credit extension and balance sheet growth) could be safely ignored.

Ref: Embrechts ICA 2010
Lesson #9: *Mindful of Financial Models*

Over-reliance on models - need to apply common sense & judgement...

Constant Variance Models – vs. RSLN; ARCH & GARCH time series models

VSTOXX Index

Normal Distribution vs. Fat Tails; Extreme Value Theory

Stock market crash of 1987 & interest rate movements of 1992 where 22 sigma events…
Lesson #9: *Mindful of Financial Models*

capital market models - is the EMH still relevant?

- **Efficient Market Hypothesis (EMH)**
  - based on numerous *assumptions* (e.g. rational behavior, symmetrical information, etc.)
  - given us - *diversification*; CAPM; alpha; etc.
  - attacked by *critics* – especially after GFC

- **Alternative theories:**
  - **Behavioral Finance** – application of psychology to finance – e.g. herd behavior; overconfidence; etc.
  - **Adaptive Markets Hypothesis (AMH)** – reconciles market efficiency with behavioral alternatives by applying the principles of evolution, competition, adaptation, and natural selection to financial interactions.
  - **Game Theory** – techniques have allowed insights into a number of empirical phenomena – e.g. signaling; etc.
  - **Fractal Methods** – “wild randomness”
Lesson #9: *Mindful of Financial Models*

modelling financial markets is complex...

10 Heresies of Finance:

1. Markets are **turbulent** – they are difficult to model
2. Markets are **very risky** – more risky than the standard theories imagine
3. Market **timing** matters greatly. Big gains and losses concentrate into small packages of time
4. Prices often **leap**, not glide, that adds to the risk
5. In markets, time is flexible
6. Markets in all places and ages work alike
7. Markets are inherently uncertain and bubbles are inevitable
8. Markets are deceptive
9. Forecasting prices may be perilous, but you can estimate the odds of future volatility
10. In financial markets, the idea of “value” has limited value.

Ref: Benoit Mandelbrot
Lesson #9: **Mindful of Financial Models**

*models built on many conditions & assumptions…*

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The Black-Scholes Formula(s)

\[
c = S_0 \, N(d_1) - K \, e^{-rT} \, N(d_2)
\]

\[
p = K \, e^{-rT} \, N(-d_2) - S_0 \, N(-d_1)
\]

where

\[
d_1 = \frac{\ln(S_0 / K) + (r + \sigma^2 / 2)T}{\sigma \sqrt{T}}
\]

\[
d_2 = \frac{\ln(S_0 / K) + (r - \sigma^2 / 2)T}{\sigma \sqrt{T}} = d_1 - \sigma \sqrt{T}
\]

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Case Study - why Warren Buffet sells long term equity puts:

- if the Black-Scholes formula is applied to **extended time periods** it can produce absurd results
- users **ignore caveats** to model
- though historical **volatility** is a useful concept in valuing short-term options, its utility diminishes rapidly as the duration of the option lengthens
- valuations using the Black-Scholes formula on long-term put options **overstate** the actual liability, though the overstatement will diminish as the contracts approach maturity…

*Ref: Extracts from…*  
*Berkshire Hathaway Inc.*  
*Shareholder Letter (Feb’ 2009)*  
*Warren E. Buffett*  
*Chairman of the Board*
Lesson #10: Regulation Review
focus on Basle III & Solvency II implications…

CEIOPS pointed out the following issues post crisis:

- due to the highly correlated nature of events caused by the crisis, the **standard formula** for SCR needs to be **revised**
- increasing focus on **stress tests** & scenario analysis
- **tail risks** tend to correlate in times of stress
- **diversification** benefits may have been overstated in the recent past
- risks considered less relevant previously (e.g. **liquidity**, **operational risks**) have hit banks in an unprecedented way
- not all **own funds** are of the same **quality**; only high-quality capital elements can truly be a first line of defence
- **approval** for internal models now more demanding…
Lesson #10: Regulation Review

Obama Financial Regulatory Reform Bill in the US...

2’300 page bill – key elements:

- **SYSTEMIC RISK** - a council of regulators chaired by the secretary of the Treasury would be created to monitor big-picture risks in the financial system.
- **ENDING BAILOUTS** - set up an "orderly liquidation" process.
- **SUPERVISING BANKS** - banks would be barred from converting their charters to escape regulatory enforcement actions.
- **HEDGE FUNDS** - private equity and hedge funds with assets of $150 million or more would have to register with the SEC.
- **INSURANCE** - a new federal office would be created to monitor, but not regulate, the insurance industry, which is now policed only at the state level.
- **VOLCKER RULE** - bar proprietary trading unrelated to customers' needs at banks that enjoy government backing.
- **INTERNATIONAL** - raise International Regulatory Standards and Improve International Cooperation.
- etc…
Lesson #10+: **Back to the Basics**

many more lessons – but here are some basics to end with…

- **Moral Hazard**
  - securitization
  - government

- **Policyholder Behavior**
  - difficult to model
  - restore public confidence & trust

- **Information Asymmetry**
  - need to underwrite

- **Alignment of Interests**
  - incentives of management to take risks - agency costs
  - broker mis-selling
  - avoid greed, fear & complacency!

- **Product Complexity**
  - complexity vs simplicity & transparency.
  - embedded options & guarantees - sensitized
Summary – Key GFC Lessons for Actuaries…

- Lesson #1: *Monitor the Market Environment*
- Lesson #2: *Track the Trends*
- Lesson #3: *Crumbling of Capital During a Crisis*
- Lesson #4: *Consider Credit Risk*
- Lesson #5: *Lack of Liquidity During a Crisis*
- Lesson #6: *Sensitized to Systemic Risk*
- Lesson #7: *Beware of the Black Swans*
- Lesson #8: *Careful of Contagion & Tail Correlation*
- Lesson #9: *Mindful of Financial Models*
- Lesson #10: *Regulation Review*
- Lesson #10+: *Back to the Basics*
What are the Experts Saying...

famous academics...

Risks Management: Lessons from the Crisis

Talk by Myron Scholes – NUS Policy Forum, July 2010 Singapore

- Lesson #1: Capital Allocation Model
- Lesson #2: Capital structure Issues
- Lesson #3: Optimization Tools
- Lesson #4: Plan for crisis, scenario analysis
- Lesson #5 Feedback Mechanism
- Lesson #6: Reporting system for risks
- Lesson #7: Firm structure/compensation
What are the Experts Saying...

excerpts from recent books on GFC...

Paulson (former US Treasury Secretary):

1. The structural economic imbalances among the major economies of the world that led to massive cross-border capital flows are an important source of the justly criticized excesses in our financial system.

2. Our regulatory system remains a hopelessly outmoded patchwork quilt built for another day & age.

3. The financial system contained too much leverage, as evidenced by inadequate cushions of capital & liquidity. Much of the leverage was embedded in largely opaque & highly complex financial products.

4. The largest financial institutions are so big and complex that they pose a dangerously large risk.
THANK YOU VERY MUCH FOR YOUR ATTENTION

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Chief Pricing Actuary, Life Asia
gmaistry@munichre.com
# References

## 1. Risk Context & Governance

### ERM Risk Strategy
- Ch. 7, Why Is Risk Costly to a Firm?
- Ch. 8, Risk Management Strategy: Duality and Globality
- **Moody's**: No Assurance of Good Governance: Observations on Corporate Governance in the U.S. Insurance Sector

### Enterprise Risk Management Framework
- **SoA**: Enterprise Risk Management Specialty Guide, 2006
- **SoA**: Dynamic Financial Condition Analysis Handbook, Ch. 1 (background only), 8 and Appendix A
- **CAS**: Dynamic Financial Models of Property-Casualty Insurers
- **Wharton**: "Risk Measurement, Risk Management and Capital Adequacy in Financial Conglomerates"
- **Babbel & Fabozzi**, *Investment Management for Insurers*, 1999 - Ch. 1, "Risk Management by Insurers: An Analysis of the Process"

### ERM Regulatory/Industry Perspective
- Ch. 3, Structuring and Managing the Risk Management Function in a Bank
- Ch. 17, Risk Management in the Future
- **UK**: Internal Control – Guidance for Directors on the Combined Code
- **Basel**: Principles for the Management of Interest Rate Risk
- **OSFI (Canadian)**: Supervisory Framework – 1999 and Beyond
- **COSO**: ERM Integrated Framework
- **SoA**: "Responsibilities of the Actuary for Communicating Sarbanes-Oxley Controls" The Financial Reporter

### ERM Rating Agency Perspective
- **S&P**: Insurance Criteria: Refining the Focus of Insurer Enterprise Risk Management Criteria
- **Moody's**: Looks at Risk Management and the New Life Insurance Risks
# APPENDIX: ERM Cycle

## 2. ERM Risk Identification

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<tr>
<td><strong>AAA</strong>: Mapping of Life Insurance Risks, Report to NAIC</td>
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## 3. ERM Risk Quantification

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<thead>
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<tr>
<td><strong>SoA</strong>: Economic Capital for Life Insurance Companies, Monograph, 2008</td>
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<td><strong>Artzner</strong>: Coherent Risk Measures, NAAJ</td>
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<td><strong>Song Zhang</strong>: &quot;Risk Aggregation for Capital Requirements Using the Copula Technique&quot;, RM Newsletter</td>
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<tr>
<td><strong>CSFB</strong>: Credit Portfolio Modeling Handbook – Ch. 4 “Demystifying Copulas”</td>
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<tr>
<td><strong>SoA</strong>: “Actuaries, Stochasticity and Risk Management: The Real Lessons of LTCM”</td>
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</table>

## 4. Risk Response

### Reinsurance

|  |
|------------------|---|
| **Ch. 16, “Assumption”** |
| **Ch. 17, “Special Purpose Reinsurance Companies”** |

### Securitization

|  |
|------------------|---|
| **Wharton**: Securitization of Life Insurance Assets and Liabilities |

## 5. Risk Reporting & Rewarding

### Economic Measures

|  |
|------------------|---|
| **Stern Stewart**: "EVA and Strategy" - |
| **Staple Inn Actuarial Society**: "Modern Valuation Techniques,” |
| **Babbel**: "Fair Value – Financial Economics Perspective”, NAAJ |
| **AAA**: "Fair Valuation of Insurance Liabilities: Principles and Methods,” Monograph |
| **Wallace**: Performance Measurement Using Transfer Pricing |
| **Crouhy**: Ch 14 Capital Alloc. & Performance Measurement |
| **Ho**: Total Return Approach to Performance Measuremen |
| **Ho**: Risk Mgmt the Total Return Approach |
| **Willis**: Maximizing Value |

### Accounting Measures

|  |
|------------------|---|
| **Fridson**: Ch. 1-4 & 13 of Financial Statement Anaylsis |
| **Tilman**: Ch. 24 Acc Stds & Requirements |
| **FASB**: Summary of Statement 157 |
| **CIA**: Stochastic Techniques Under Canadian GAAP |
# Insurance Risk References

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<td>• product risk, and</td>
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<td>• embedded options</td>
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</tbody>
</table>

- **Look at components - level, volatility, trend, shock**

## References

- **Atkinson & Dallas**, Life Insurance Products and Finance mortality risk, morbidity risk
  - FE-C169-09: Ch. 3, Pricing Assumptions
  - FE-C151-08: Ch. 13 Annuity and Investment Products
- **Max Rudolph**: “Influenza Pandemics: Are We Ready for the Next One”, RM section newsletter
- **SoA**: “Death Benefit Focused UL”, PD newsletter, April 2003
  - Ch. 16 - Understanding Options Embedded in Insurers’ Balance Sheets, by L. Rubin
## APPENDIX: Interest Rate Risk References

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<td>Duration; convexity; VaR; CTE; etc.</td>
<td>Treasuries; Hedge - interest rate derivatives; Treasury &amp; Eurodollar options</td>
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<td>Yield curve shape</td>
<td>Key rate durations; scenarios; VaR; etc.</td>
<td>Above + structured notes</td>
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<td>Volatility</td>
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<td>Swap-options; caps; floors; etc.</td>
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<td>Credit spread</td>
<td>Spread duration; VaR; holding limits</td>
<td>Interest rate swaps; credit default swaps; etc.</td>
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<tr>
<td>AFE References</td>
<td>Tilman: Asset/Liability Management of Financial Institutions, Ch. 1, The Task of Asset/Liability Management</td>
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# APPENDIX: Other Market Risk References

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<td>Forward rate agreements; foreign exchange options; currency swaps; etc.</td>
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<tr>
<td><strong>Reinvestment</strong></td>
<td>Cash flow projections; scenario analysis</td>
<td>Forward contracts</td>
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</table>

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- **Evans**: Variable Product Hedging Practical Considerations
### APPENDIX: Operational Risk References

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<th>Market Conduct (e.g., sales practices)</th>
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<td>HR risk, e.g., productivity, talent management, employee conduct</td>
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<td>Process risk, e.g., supply chain, R&amp;D</td>
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<td>Technology risk, e.g., reliability, external attack, internal attack</td>
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<td>Judicial risk, e.g., litigation</td>
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<td>Compliance risk, e.g., financial reporting</td>
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<td>Internal and External fraud</td>
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<td>Execution risk</td>
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<td>Supplier/partner risk</td>
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<td>Disaster risk, e.g., natural disaster, man-made disaster</td>
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| Operational Risk Quantification | Economic Capital (difficult) |

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<th>AFE References</th>
<th>Shah: Insurance OP Risk: The Big Unknown</th>
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<td>Rebonato: “Theory and Practice of Model Risk Management”</td>
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<td>Ch. 15, Model Risk</td>
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<td>G30: Derivatives: Practice and Principles (pp. 13-24 and 43-52)</td>
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# APPENDIX: Strategic Risk References

| Strategic Risk Identification | - Product sustainability risk  
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|                              | - Consumer preferences and demographics  
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|                              | - Competitor risk  
|                              | - External relations risk  
|                              | - Legislative/Regulatory risk  
|                              | - Reputation Risk  
|                              | - Sovereign risk  
| Strategic Risk Quantification | ERC, MCEV, RAROC, IRR, etc.  
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