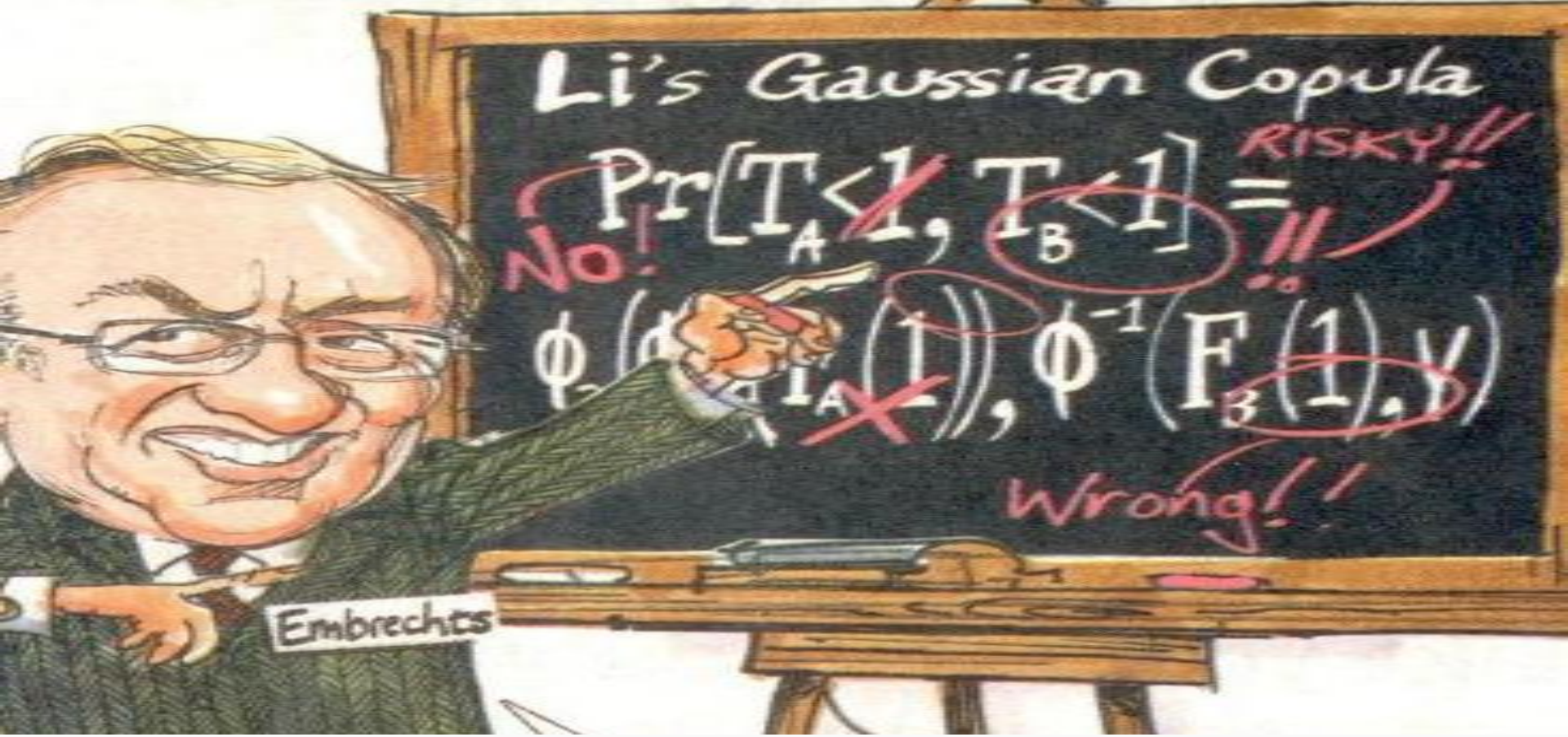

MANAGING RISK IN THE NEW WORLD – POST FINANCIAL CRISIS

- KEY LESSONS FOR ACTUARIES

SAS AFTERNOON TALK
SINGAPORE, 29 JULY 2010

Singapore Actuarial Society

Gavin R. Maistry, FSA, FSAS, CERA, CFA
Chief Pricing Actuary, Life Asia

Munich RE

Cape Town Afrique du Sud
iCA 2010 CiA

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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

Cape Town Afrique du Sud
ICA 2010 CIA

- renowned **keynote speakers** including:

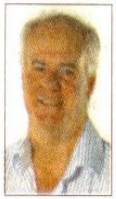
www.ica2010.com

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

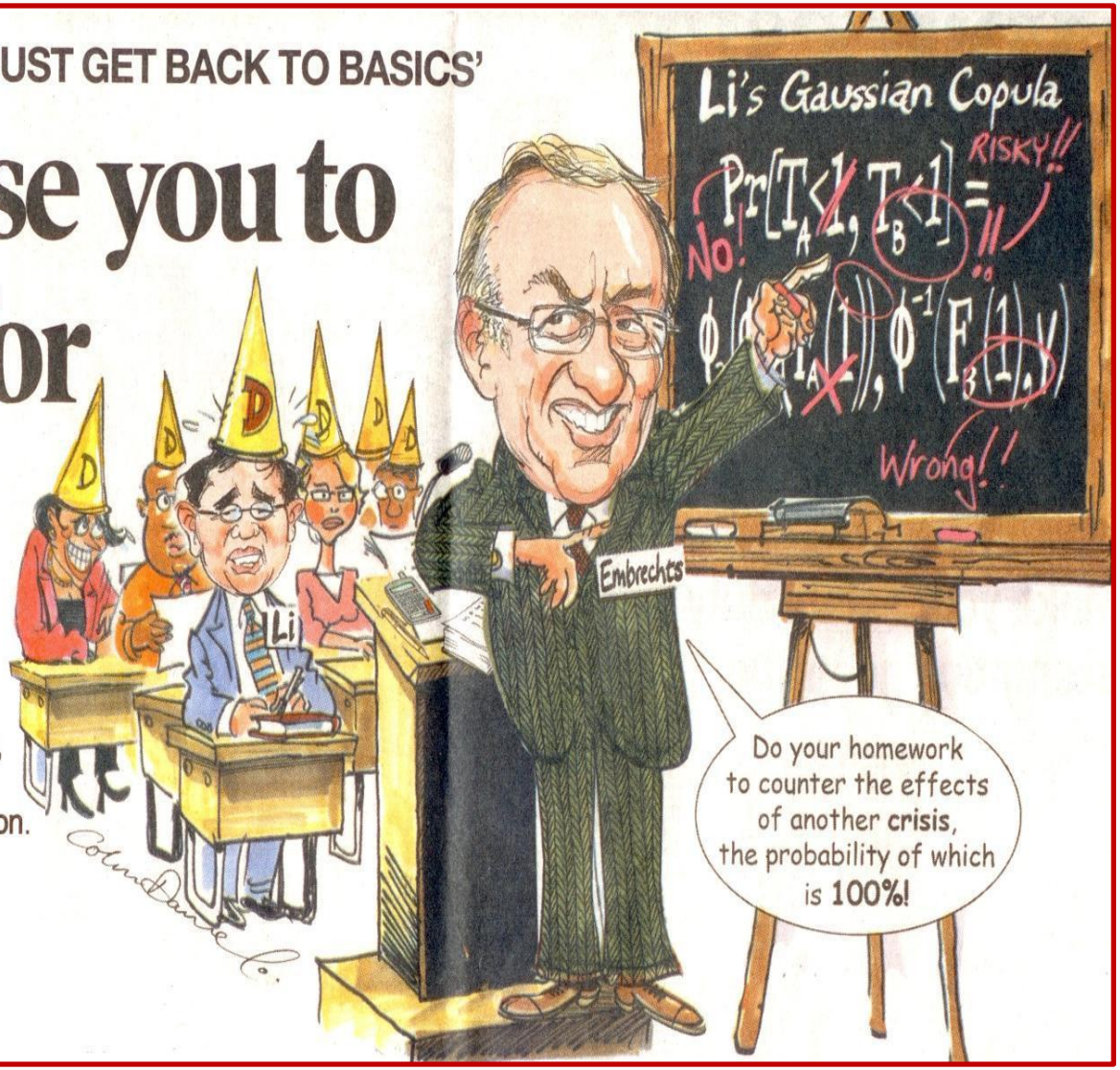
Actuarial Profession at the Forefront of Risk Management

■ BANKERS AND ACTUARIES 'MUST GET BACK TO BASICS'

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**.

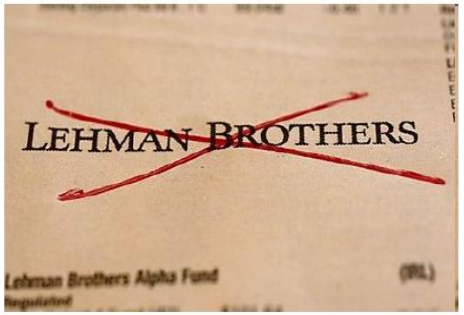


AGENDA: 10 Key Lessons of the GFC

was mainly a banking crisis but important lessons for actuaries…

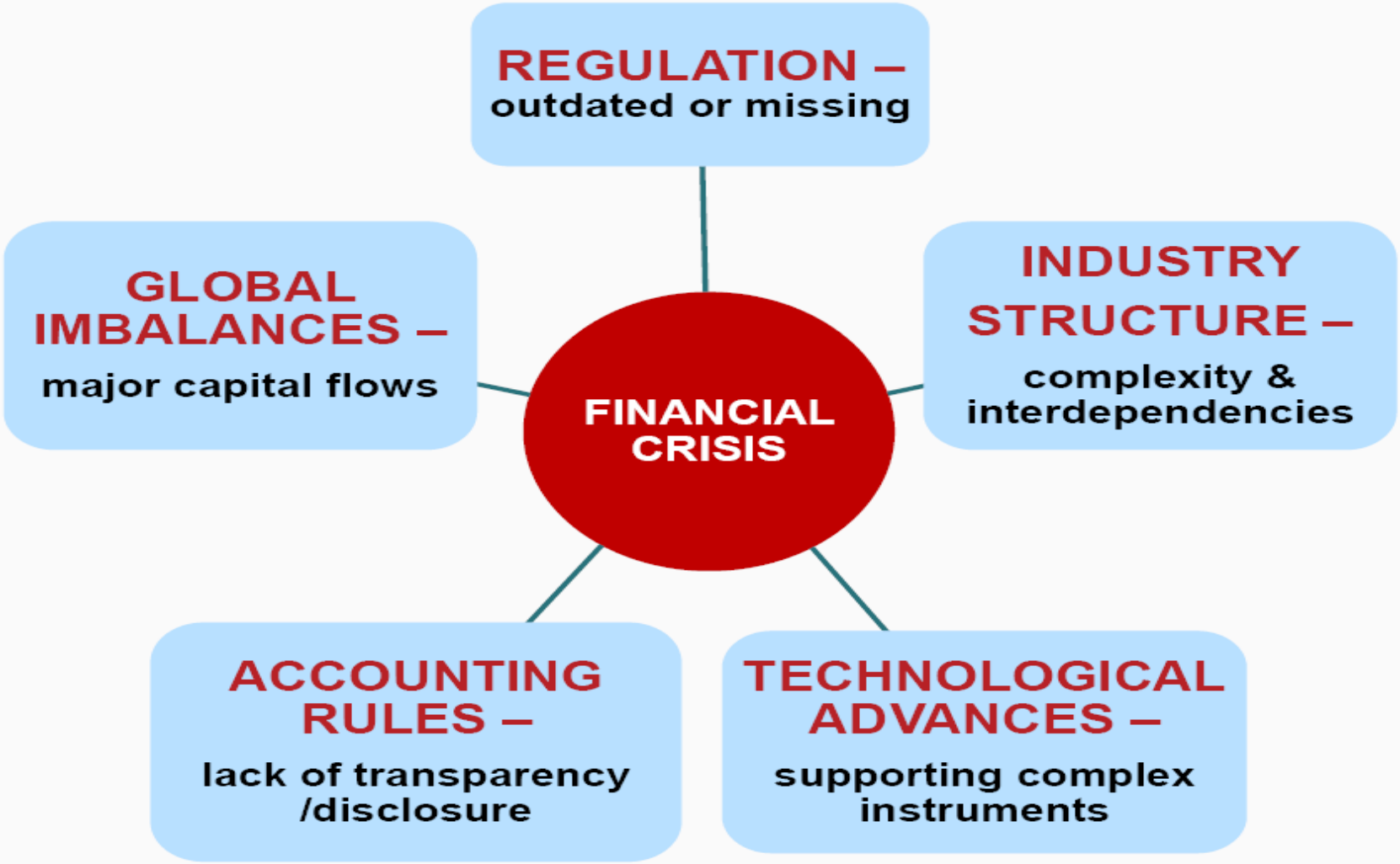
The Scream of the Banker…

with apologizes to Edvard Munch



Lesson #1: ***Monitor*** **the Market Environment**

prior to the GFC…



Lesson #2: ***Track*** **the Trends**

prior to the GFC…

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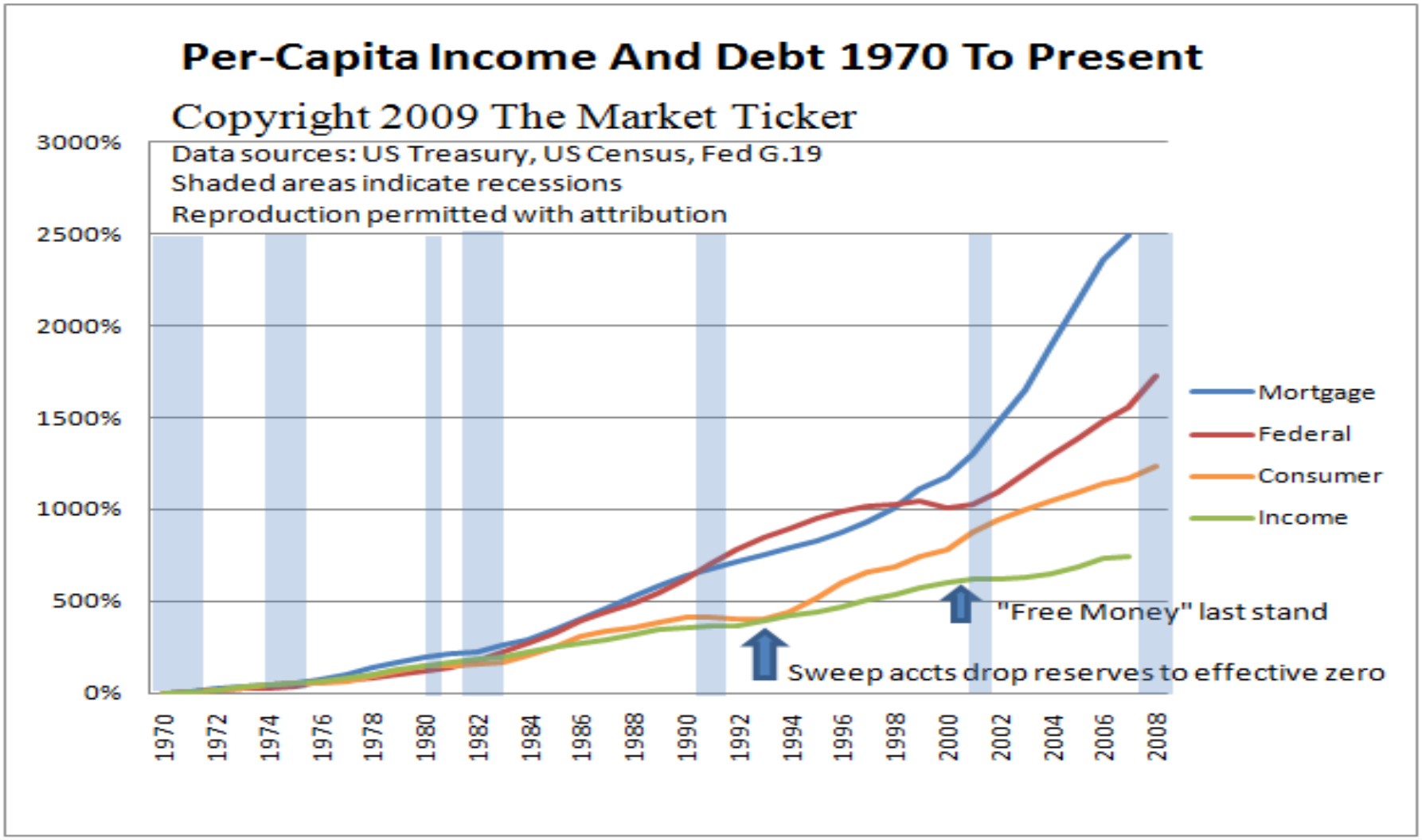
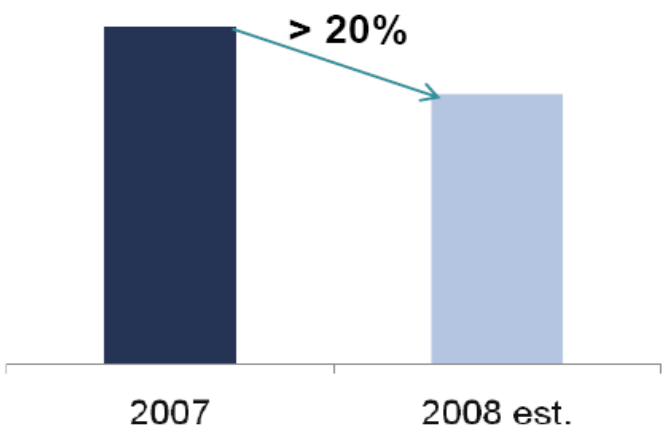


Lesson #3: *Crumbling* of Capital During a Crisis

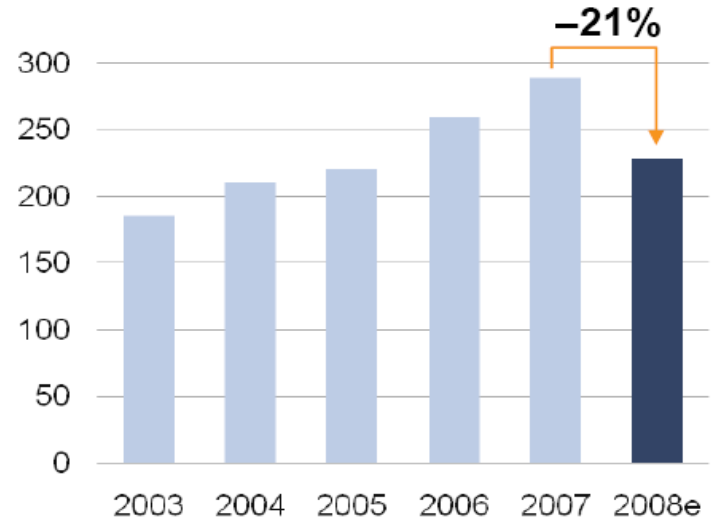
and the need for more robust solvency & risk management…

Insurance sector capitalization (Accounting view)

Reduction in primary insurers capital[1]



Shareholders' equity of reinsurers is declining for the first time in years (year-end[2] US$ bn)



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

[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…

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Reduction of capital requirements / Increase available capital:

Assets: **Reduce Required Capital**: De-risk	**Re-allocations within investment portfolios** ▪ Sale of participations ▪ Reduction of equity ratio
Liabilities: **Reduce Required Capital**: De-risk **Reduce Liabilities**	**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

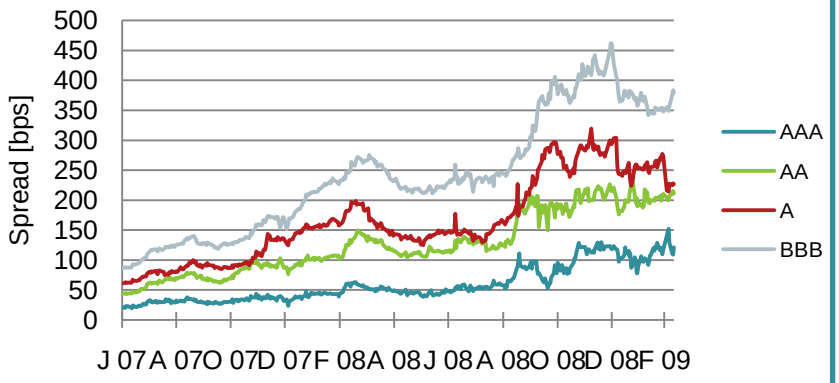
Increase Capital	**Capital structure**
	▪ Increase equity, hybrids , subordinated debt
	▪ Increase income
	  ▪ Reinsurance
	  ▪ Sale of blocks/companies
	  ▪ Reduce sales of high strain business

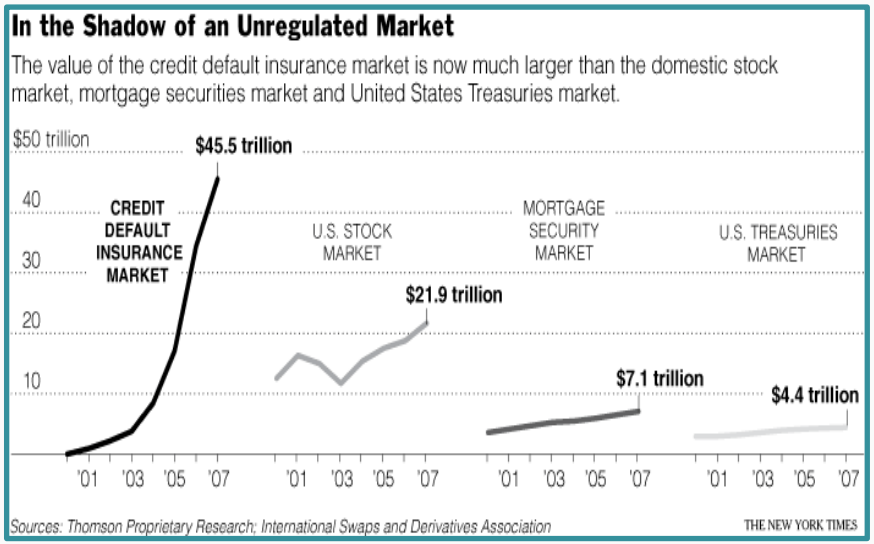
Lesson #4: ***Consider*** **Credit Risk**

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…

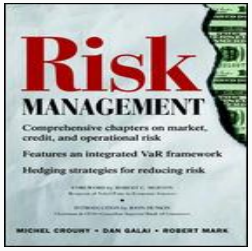
EUR corporate spreads (10 years)

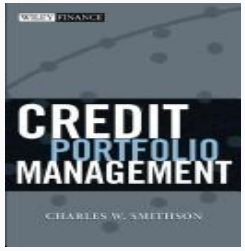




APPENDIX: Credit Risk References

Credit Risk Identification	Credit Risk Quantification	Credit Risk Management
Credit spreads	Spread duration; VaR; CreditMetrics	interest rate swaps; credit default swaps; total return swaps
Default risk	Credit ratings; KMV	credit default swaps; structured products; Ratings; capital
Counter-party risk **Receivables**	Credit limits default probabilities	credit derivatives, diversification, concentration limits, and credit support agreements. due diligence and aggregate counter-party exposure limits.
References	❑ 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…

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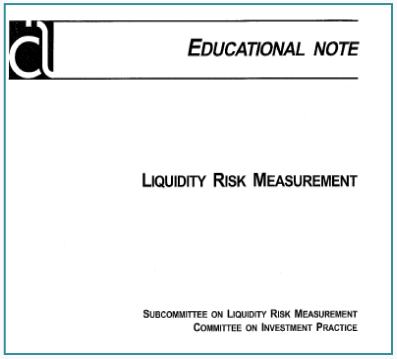
- Liquidity risk is measure of probability that company's **cash resources** will be insufficient to meet current or future cash needs
- Valuable **capital assets** can become illiquid. Hence holding sufficient capital does not guarantee liquidity.
- During the GFC liquidity **disappeared** on most assets – 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

Liquidity Risk Identification	Liquidity Risk Quantification	Liquidity Risk Management
Forced selling & margin calls	Stress testing	sizing of liquid versus liiliquid positions
Inability to satisfy liabilities	Scenario analysis	cash flow management
cashflow strain run on the bank hidden callable options	liquidity ratios; scenarios; etc.	diversification surrender charges contract design
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?

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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…

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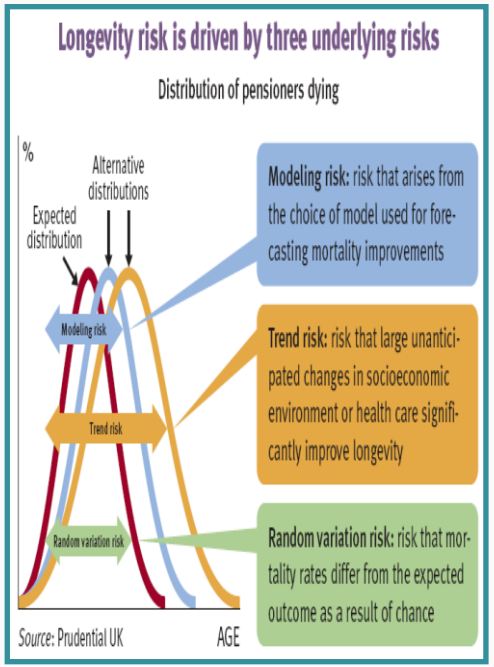
- Not a well-defined concept. Broadly defined as the risk of an event that would cause the **collapse of a market or financial system** (as opposed to the collapse of a single entity)
- Recent **regulatory** focus due to financial crisis
- Systemic risk **lower** compared to **banking** - fewer counterparties, 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

THE GENEVA ASSOCIATION
Risk & Insurance Economics

Systemic Risk in Insurance
An analysis of insurance and financial stability
Special Report of The Geneva Association Systemic Risk Working Group



Lesson #7: ***Beware*** **of the Black Swans**

still many unknowns…

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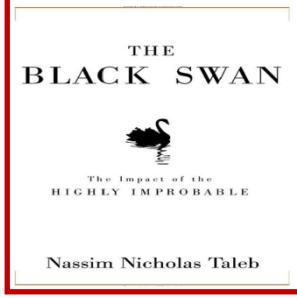
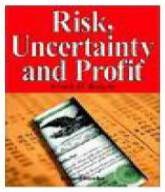
- Black Swans – the "**unknown unknowns**"
- **Data risk** – is the past a good guide to the future – very relevant to actuaries
- Understand difference between **risk** & **uncertainty**
- The (6) **Mistakes** Executives Make in Risk Management (*Taleb, et al*):
  1. we think we can manage risk by predicting extreme events – need to <u>insure/hedge</u> 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 absence of evidence is not an evidence of absence"

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

- Risk: randomness with knowable probabilities, and
- Uncertainty: randomness with unknowable probabilities
- A reference: "The Known, the Unknown, and the Unknowable in Financial Risk Management: Measurement and Theory Advancing Practice", Edited by Francis X. Diebold, Neil A. Doherty & Richard J. Herring



Ref: Embrechts ICA 2010

Frank H. Knight, 1921

Lesson #8: *Careful* of Contagion & Tail Correlation

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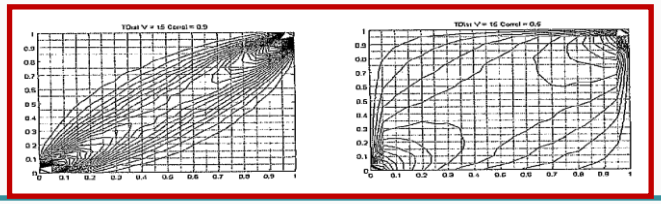
many interdependencies…

- 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.

$$\Pr[T_A<1, T_B<1] = \phi_2(\phi^{-1}(F_A(1)), \phi^{-1}(F_B(1)), \gamma)$$

Johnny Cash and June Carter

Lesson #9: *Mindful* of Financial Models

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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.

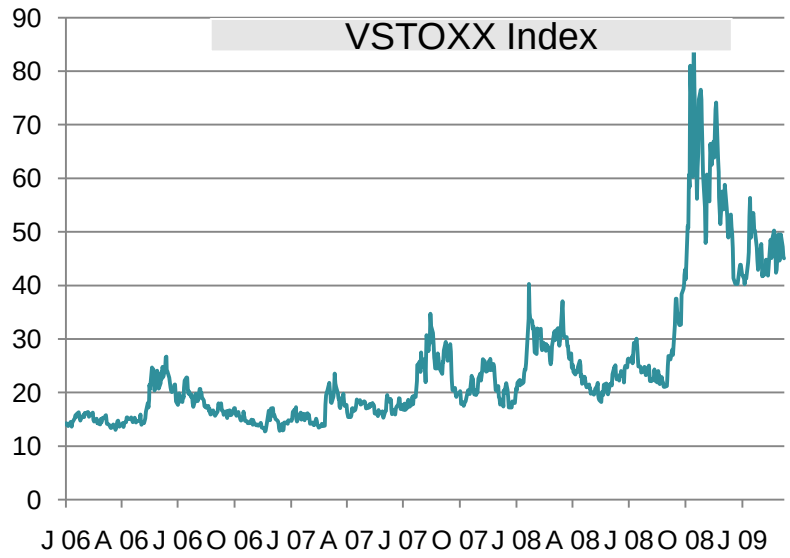
Ref: Embrechts ICA 2010

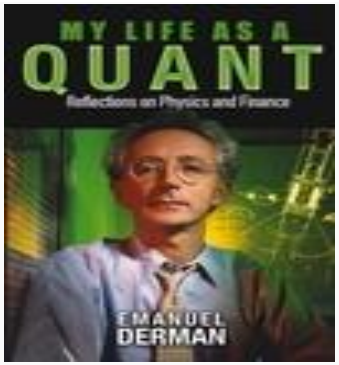
Lesson #9: *Mindful* of Financial Models

Munich RE

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

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

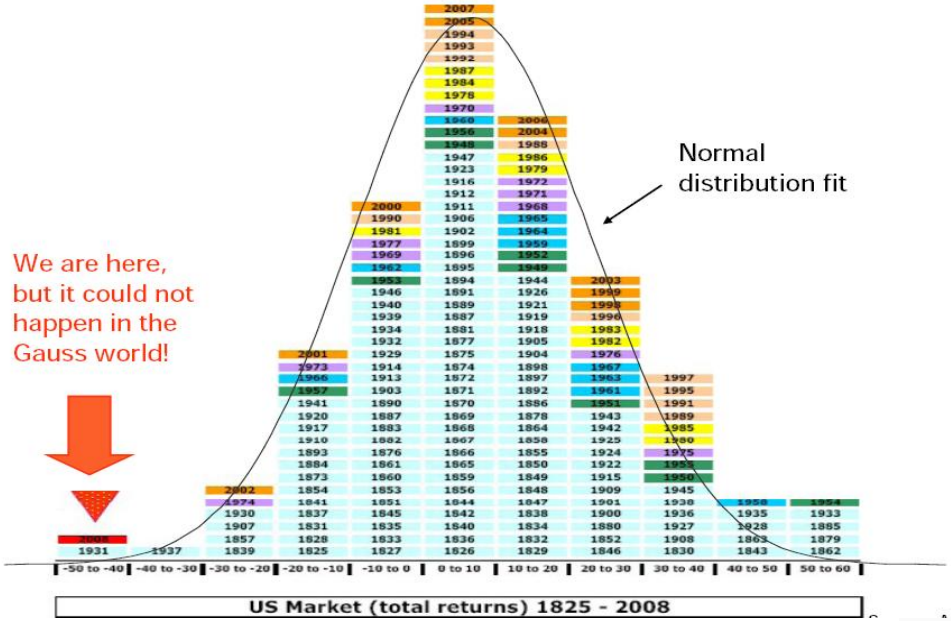




Stock market crash of 1987 & interest rate movements of 1992 where 22 sigma events…

Normal Distribution vs. Fat Tails; Extreme Value Theory

Extreme Value Theory; Fat Tails; etc.



Pr >	Pr
0 σ	1 in 2 times
1 σ	1 in 6.3 times
2 σ	1 in 44 times
3 σ	1 in 740 times
…	
10 σ	1 in 130 x 10^{21} times
22 σ	1 in 1 x 10^{100} times

Lesson #9: *Mindful* of Financial Models

capital market models - is the EMH still relevant?

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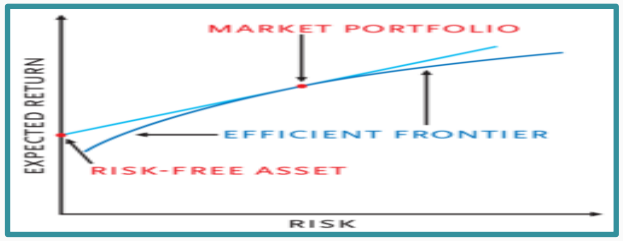
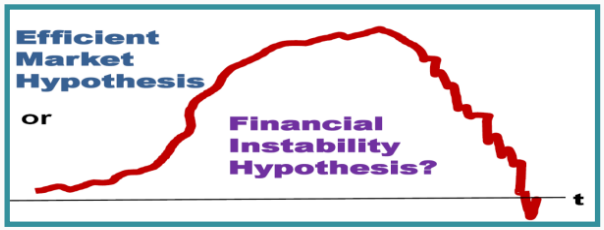


- **Efficient Market Hypothesis (EMH)**
  - based on numerous **assumptions** (e.g. rational behavior, symmetrical information, etc.)
  - given us - **diversification**; CAPM; alpha; etc.
  - attacked by **critics** – especially after GFC



- *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"

Daniel Kahneman

Andrew Lo

John Nash

Benoit Mandelbrot

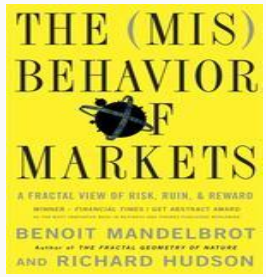
Lesson #9: *Mindful* of Financial Models

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…

The Black-Scholes Formula(s)

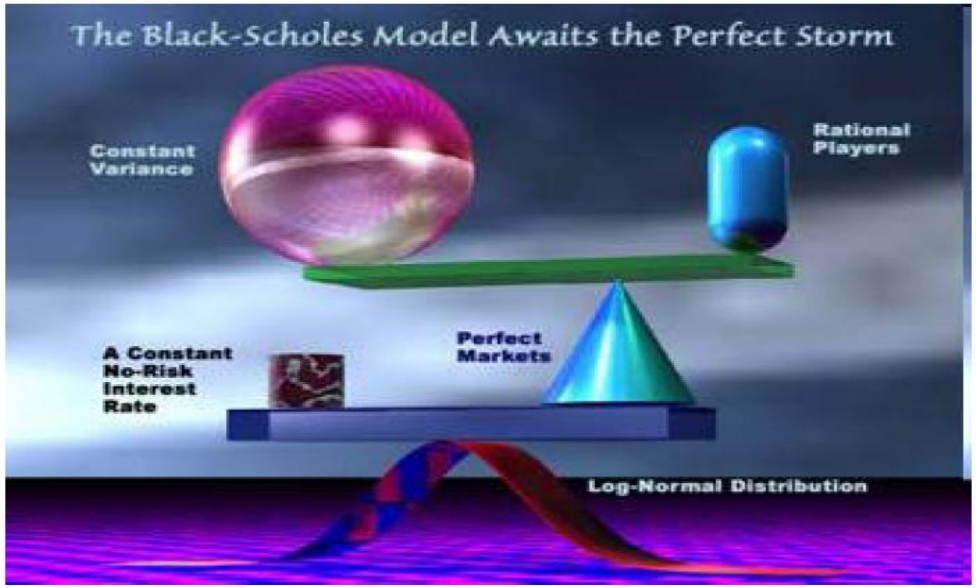
Conditions

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

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

where $d_1 = \dfrac{\ln(S_0 / K) + (r + \sigma^2 / 2)T}{\sigma\sqrt{T}}$

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



Ref: Embrechts ICA 2010

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

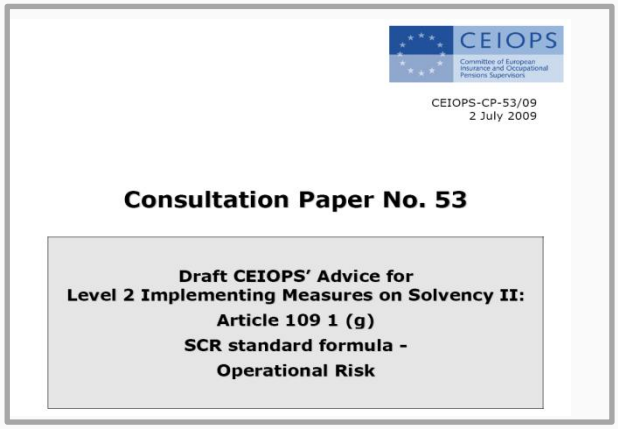
Lesson #10: **Regulation** ***Review***

focus on Basle III & Solvency II implications…

Munich RE

Basel Basics | A look at the international banking accord under negotiation

UNOFFICIAL NAME	Basel III, which derives from the Swiss city in which the pact is negotiated. The prior two versions were agreed to in 1988 and 2004.	
OVERALL	**The goal:** Require banks to maintain stronger, less-risky financial profiles	**The hitch:** Implementation of the rules is likely to take up to a decade
CAPITAL	**The goal:** Require banks to hold thicker capital cushions to insulate them from losses	**The hitch:** Countries are haggling over definitions and seeking exemptions for certain banks
LIQUIDITY	**The goal:** Require banks to hold more long-term, stable funding	**The hitch:** The proposal could cause huge funding shortfalls for banks world-wide
LEVERAGE	**The goal:** Require banks to cut down on risk-magnifying leverage	**The hitch:** Europe wants individual countries to have discretion, rather than a global rule


CEIOPS
Committee of European Insurance and Occupational Pensions Supervisors

CEIOPS-CP-53/09
2 July 2009

Consultation Paper No. 53

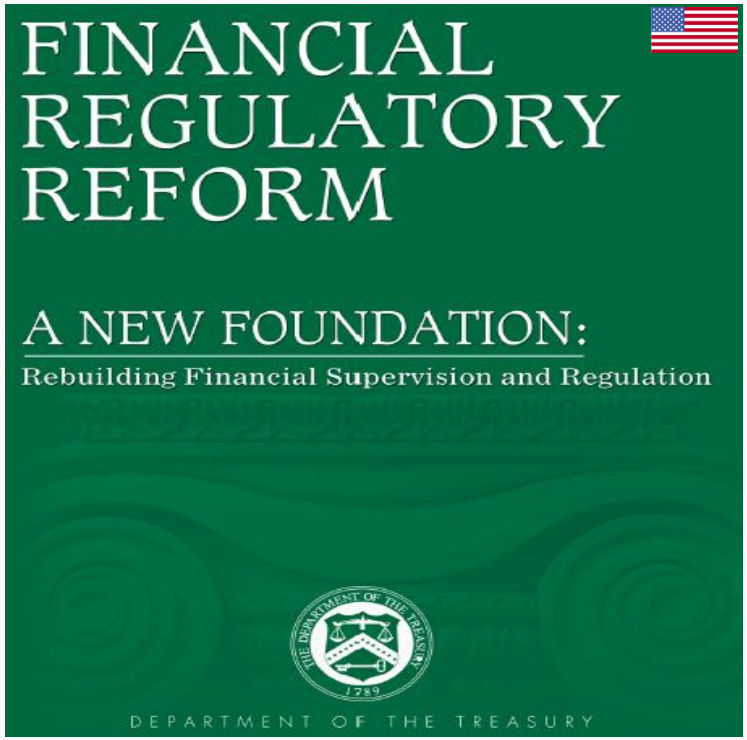
Draft CEIOPS' Advice for Level 2 Implementing Measures on Solvency II: Article 109 1 (g) SCR standard formula - Operational Risk

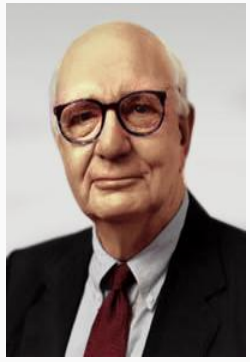
CEIOPS pointed out the following issues post crisis:

- 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**

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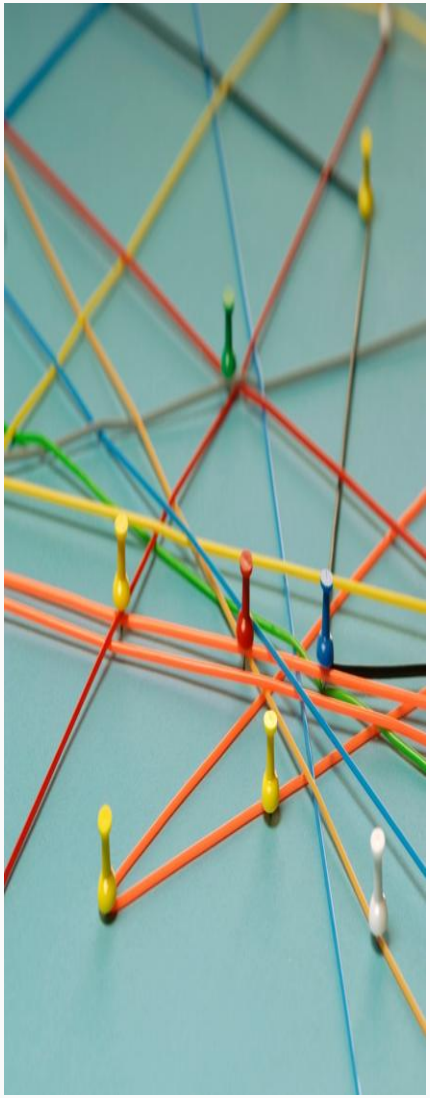
many more lessons – but here are some basics to end with…

- **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: **C*onsider*** **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...

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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...

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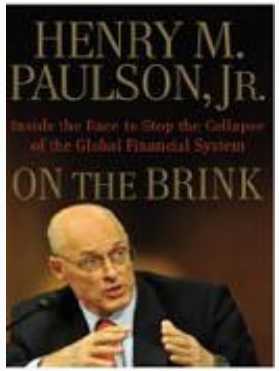
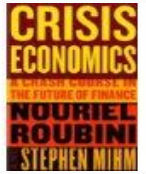
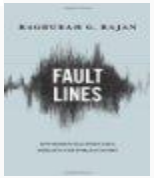
excerpts from recent books on GFC...

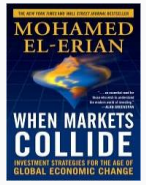
Paulson (former US Treasury Secretary):

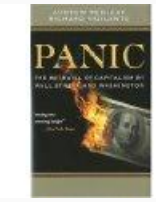
1. The structural **economic imbalances** among the major economies of the world that led to massive cross-border capital flows are an important source of the justly criticized excesses in our financial system
2. Our **regulatory system** remains a hopelessly outmoded patchwork quilt built for another 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

Gavin R. Maistry, FSA, FSAS, CERA, CFA
Chief Pricing Actuary, Life Asia
gmaistry@munichre.com

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APPENDIX CERA Chartered Enterprise Risk Analyst CREDENTIAL References…

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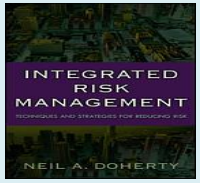
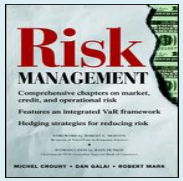
1. Risk Context & Governance *(AFE References)*  	**ERM Risk Strategy**	❑ Doherty, Integrated Risk Management, Ch. 1, The Convergence of Insurance Risk Management & Financial Risk Management Ch. 7, Why Is Risk Costly to a Firm? Ch. 8, Risk Management Strategy: Duality and Globality ❑ Moody's: No Assurance of Good Governance: Observations on Corporate Governance in the U.S. Insurance Sector
	Enterprise Risk Management Framework	❑ SoA: Enterprise Risk Management Specialty Guide, 2006 ❑ Crouhy, Galai, & Mark, Risk Management, 2001, Ch. 3, Structuring and Managing the Risk Management Function in a Bank ❑ 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	❑ Crouhy, Galai, & Mark, Risk Management, 2001, Ch. 2, The New Regulatory and Corporate Environment" 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: "Actuarial Aspects of SOX 404", The Financial Reporter, Dec. 2004 ❑ 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 ❑ Best Rating: Risk Management and the Rating Process for Insurance Companies, January 2008. ❑ Moody's Looks at Risk Management and the New Life Insurance Risks

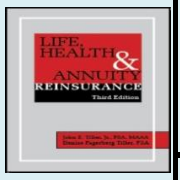
APPENDIX: ERM Cycle

2. ERM Risk Identification *(AFE Reference)*	❑ AAA: Mapping of Life Insurance Risks, Report to NAIC

2. Risk Identification

3. ERM Risk Quantification *(AFE References)*	❑ SoA: Economic Capital for Life Insurance Companies, Monograph, 2008 ❑ Artzner: Coherent Risk Measures, NAAJ ❑ Song Zhang: "Risk Aggregation for Capital Requirements Using the Copula Technique", RM Newsletter ❑ CSFB: Credit Portfolio Modeling Handbook – Ch. 4 "Demystifying Copulas" ❑ SoA: "Actuaries, Stochasticity and Risk Management: The Real Lessons of LTCM

3. Risk Quantification

4. Risk Response *(AFE References)* 	**Reinsurance**	❑ Tiller, Life, Health and Annuity Reinsurance, 3rd Edition., 2005, Ch. 5, "Advanced Methods of Reinsurance" Ch. 16, "Assumption" Ch. 17, "Special Purpose Reinsurance Companies"
	Securitization	❑ Wharton: Securitization of Life Insurance Assets and Liabilities

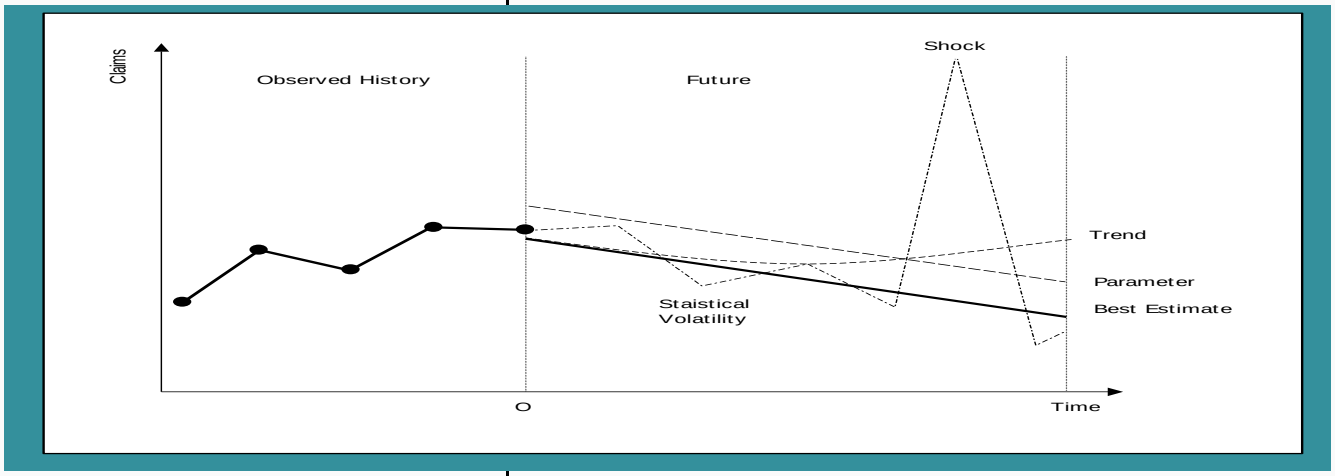
4. Risk Response

5. Risk Reorting & Rewarding *(AFE References)*	**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 ❑ H. Mueller: "An Overview of Embedded Value" , Financial Reporter ❑ 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 Anaysis ❑ Tilman: Ch. 24 Acc Stds & Requirements ❑ FASB: Summary of Statement 157 ❑ CIA: Stochastic Techniques Under Canadian GAAP

5. Risk Monitoring, Reporting & Rewarding

APPENDIX: Insurance Risk References

Insurance Risk Identification	Insurance Risk Quantification	Insurance Risk Management
❑mortality risk ❑morbidity risk ❑lapse risk ❑product risk, and ❑embedded options **look at components - level, volatility, trend, shock**	Economic Capital	margins capital reinsurance, securitization
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 ❑Tilman, Asset/Liability Management of Financial Institutions, 2003 Ch. 16 - Understanding Options Embedded in Insurers' Balance Sheets, by L. Rubin	



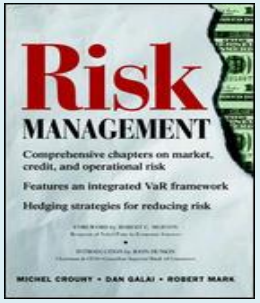
APPENDIX: Interest Rate Risk References

Interest Rate Risk Identification	Interest Rate Risk Quantification	Interest Rate Risk Management
Interest rate level	Duration; convexity; VaR; CTE; etc.	Treasuries; Hedge - interest rate derivatives; Treasury & Eurodollar options
Yield curve shape	Key rate durations; scenarios; VaR; etc.	Above + structured notes
Volatility	Volatility durations; VaR	Swap-options; caps; floors; etc.
Credit spread	Spread duration; VaR; holding limits	Interest rate swaps; credit default swaps; etc.
AFE References	❑ Tilman: Asset/Liability Management of Financial Institutions, Ch. 1, The Task of Asset/Liability Management ❑ Briys: Life Insurance Pricing and the Measurement of the Duration of Liabilities (interest rate risk) ❑ Ho: Key Rate Durations: Measures of Interest Rate Risks ❑ SoA: Fixed Annuities in Low Interest Rate Environment", Product Development newsletter, April 2003	❑ Swiss Re: Asset Liability Management for Insurers ❑ Glacy: Asset/ Liability Management, IASA Handbook ❑ Rubin: Hedging with Derivatives in Traditional Insurance Products ❑ Rubin: Long-Term Economic and Market Trends and Their Implications for Asset-Liability Management of Insurance Companies ❑ Basle: Principles for the Management of Interest Rate Risk ❑ Tilman, Asset/Liability Management of Financial Institutions, 2003 - Ch. 25, Implications of Regulatory and Accounting Requirements for Asset/Liability Management Decisions, by Hida, Habayeb, Yetis, & Sethi.

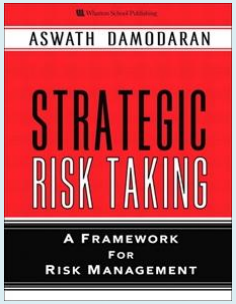
APPENDIX: Other Market Risk References

Market Risk Identification	Market Risk Quantification	Market Risk Management
Equity - guarantees retained by the company	Betas; VaR; CTE; stress testing	hedge, ALM - Equity derivatives dynamic hedging
Commodity	Notional exposures; VaR; stress testing	Commodity futures & options
Foreign exchange	Notional exposures; VaR; stress testing	Forward rate agreements; foreign excahenge options; currency swaps; etc.
Reinvestment	Cash flowprojections; scenario analysis	Forward contracts
AFE References	❑ Brizeli: Variable Annuity – "No Loss" Propositions ❑ Hardy, Investment Guarantees, 2003 (equity risk) Ch.1, Investment Guarantees, Ch. 6, Modeling the Guarantee Liability Ch. 8, "Dynamic Hedging" Ch.9, "Risk Measures" Ch.10, "Emerging Cost Analysis" Ch.11, "Forecast Uncertainty" Ch.11, "Guaranteed Annuity Options" ❑ SoA: "Managing Variable Policyholder Behavior Risk", PD newsletter, March 2005 ❑ SoA: "Whither the Variable Annuity", PD newsletter, November 2003 ❑ Crouhy, Galai, & Mark, Risk Management, 2001 Ch.5, "Measuring Market Risk: The VaR Approach Ch.6, "Measuring Market Risk: Extensions of the VaR Approach ❑ Moody's: Hedging the Bet, Variable Annuity Bells and Whistles. ❑ Evans: Variable Product Hedging Practical Considerations	

APPENDIX: Operational Risk References

Operational Risk Identification *The risk of direct or indirect loss resulting from inadequate or failed* internal processes, people, systems or from external events…	❑ Market Conduct (e.g., sales practices) ❑ HR risk, e.g., productivity, talent management, employee conduct ❑ Process risk, e.g., supply chain, R&D ❑ Technology risk, e.g., reliability, external attack, internal attack ❑ Judicial risk, e.g., litigation ❑ Compliance risk, e.g., financial reporting ❑ Internal and External fraud ❑ Execution risk ❑ Governance risk ❑ Supplier/partner risk ❑ Disaster risk, e.g., natural disaster, man-made disaster ❑ MODEL Risk
Operational Risk Quantification	Economic Capital (diificult)
Operational Risk Management	COSO Guidelines SoX …
AFE References 	❑ Shah: Insurance OP Risk: The Big Unknown ❑ SoA: "Operational and Reputational Risks: Essential Components of ERM", Risk Management, Dec 2006. ❑ SoA: Enterprise Risk Management Specialty Guide, 2006 ❑ Rebonato : "Theory and Practice of Model Risk Management" ❑ Crouhy, Galai, & Mark, Risk Management, 2001 Ch. 13, Mananging Operational Risk Ch. 15, Model Risk ❑ G30: Derivatives: Practice and Principles (pp. 13-24 and 43-52) ❑ Khan: "Why COSO Is Flawed," Jan 2005.

APPENDIX: Strategic Risk References

Strategic Risk Identification *The risk of direct or indirect adverse impact on the operating results or value of the business unit as a result of the strategies not being optimally chosen, implemented or adapted to changing conditions…*	❑ Product sustainability risk ❑ Distribution sustainability risk ❑ Consumer preferences and demographics ❑ Geopolitical risk ❑ Competitor risk ❑ External relations risk ❑ Legislative/Regulatory risk ❑ Reputation Risk ❑ Sovereign risk
Strategic Risk Quantification	ERC, MCEV, RAROC, IRR, etc.
Strategic Risk Management	Risk Analysis & Quantification Tables
AFE References 	❑ HBR: "Countering the Biggest Risk of All" by Slywotzky and Drzik, April 2005 ❑ "Moody's Looks at Terrorism Risk in the U. S. Life Insurance Industry," ❑ Damoradan, Strategic Risk-Taking, 2006(?) • Ch. 9, Risk Management: The Big Picture • Ch. 10, Risk Management: Profiling and Hedging • Ch. 11, Strategic Risk Management • Ch. 12, Risk Management: First Principles