

# Risk Management: Then, Now and Tomorrow

(some personal recollections)

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The Institute of Actuaries of Japan, 14/9/2016

# RM: Then [1950 - 2004]

(for the moment I mainly concentrate on **banking** and will come back to **insurance later**)

Modern insurance risk management requires a **Principles-based** approach. A consolidated **Asset-Liability** view plays a fundamental role.

# RM: Then (1) – (pre-)history

- For this talk, “**Then**” starts around 1950
  - 1952: saw the appearance of Harry Markowitz’ **mean-variance framework**, from then on **return** would be looked at **together** with **risk**
  - 1960s: **CAPM** = the **Capital Asset Pricing Model** (Treyner, Sharpe, Lintner, ...), with many generalizations later
  - **1963: Benoit Mandelbrot**, (J. Business **36**(4), 394-419) concluded that **the empirical distribution of financial data does not fit the assumption of “normality (Gaussianity)”**; **data are non-Gaussian, heavy tailed**
  - In 1964, Paul Cootner (MIT-Sloan) added:  
**If Mandelbrot is right, almost all of our statistical tools are obsolete!**
- ➔ **Mandelbrot was right** and till today, industry does not really grasp **the consequences of the “non-normality of markets”!**

# RM: Then (2) – 1970s till early 2000

- 1973: (first) **Oil Crisis**
- 1973: End of the **Bretton-Woods** System (1968-1973) ... 1974: **Herstatt Crisis/Risk** (FX)
- 1970s: An enormous growth in availability and capacity of **IT-Technology**
- 1973: **Black-Scholes-Merton** Option Pricing Formula triggering the **GREAT BOOM** in derivatives trading, the **BUST** came much later! See (\*) →

**Remark: This period of increased economic and geopolitical risk created an insatiable hunger (demand) for financial derivatives!**

- The early **Basel Accords** (in **partial** response to these developments):
  - **Basel I** (1988): Mainly for Credit Risk, not risk sensitive, nominal “hair cuts”
  - **Basel I ½**: (1996) the birth of **Value-at-Risk** (VaR), 1994/97, Risk/Credit MetricsIn response to early 1990s disasters: e.g. 1993/94 Metallgesellschaft, 1994 Orange County, 1995 Barings Bank, 1996 Sumitomo, 1998 LTCM, ...

See (\*\*) →

**RiskLab at ETH Zurich was founded on October 7, 1994**

**RiskLab**<sup>®</sup>  
Switzerland

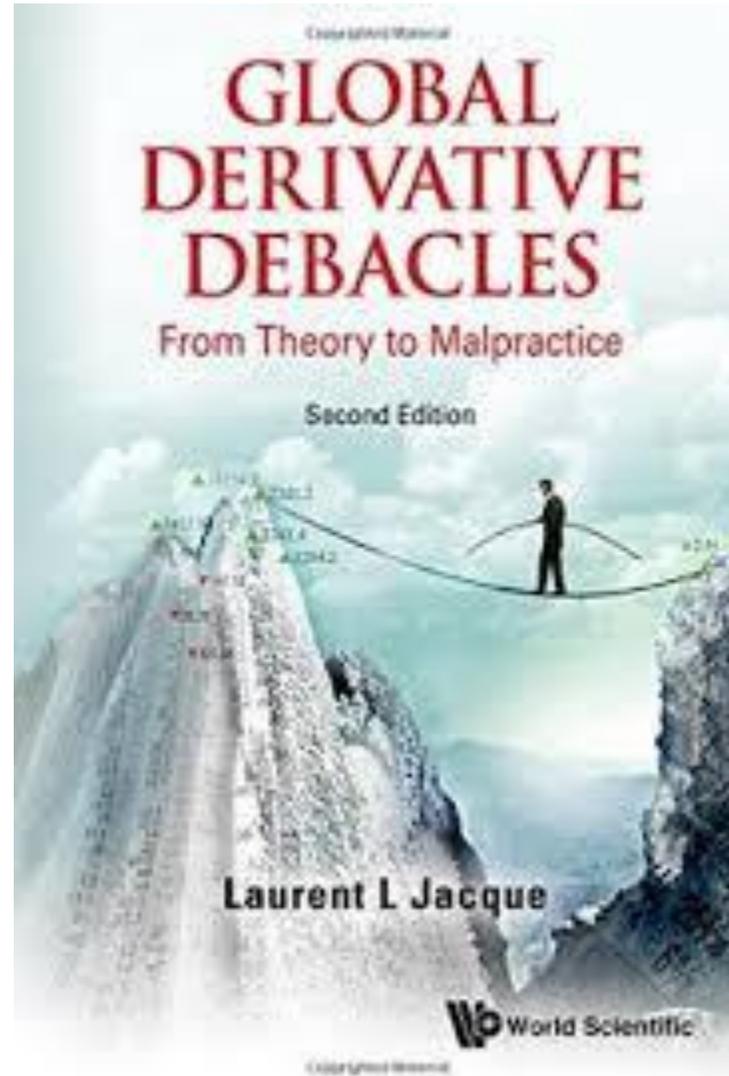
(\* ) Some achievements of **Black-Scholes** type option pricing theory:

- How to dynamically replicate and **hedge** option portfolios
- Leading to the RM technology of the “**greeks**” (delta, gamma, “vega”, ...)
- The definition and importance of **implied volatility** (and other implied parameters) as a measure of deviation of market data from model predictions

At the same time however recall that

- Derivatives typically are **non-linear** in the underlying security
- This can lead to a **very fast** change of “financial weather”: **speed** (→ e.g. AIG)
- Highly toxic in combination with **volume**: **notional**, 1.5 Quadrillion \$ (!!!)  
= (+/-) **20 x World (nominal) GDP** (1 Quadrillion \$ = 1 000 000 000 000 000 \$)

(\*\*) An interesting book:



All these **achievements** however pre-assume very specific **market conditions** like, to a varying degree:

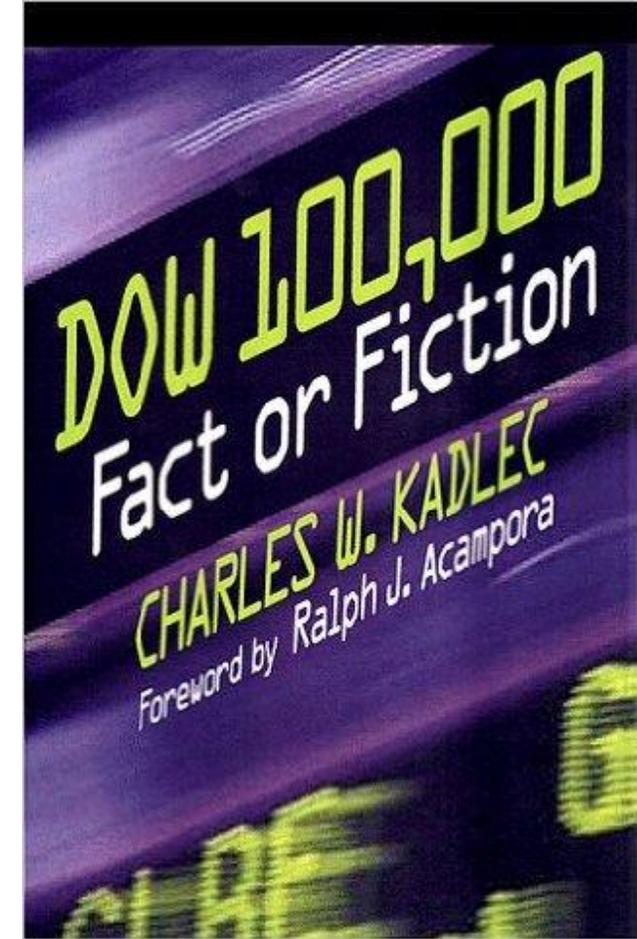
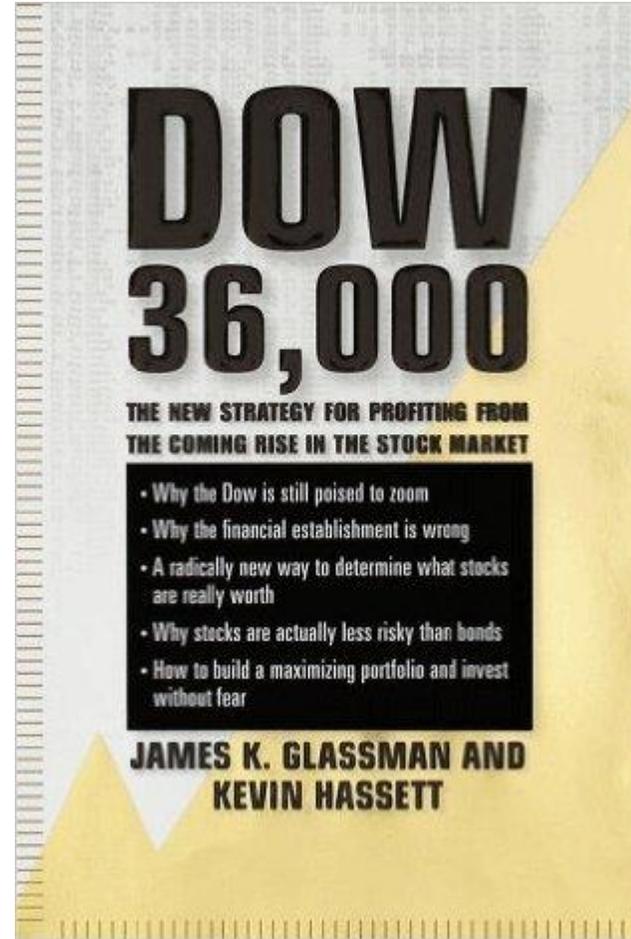
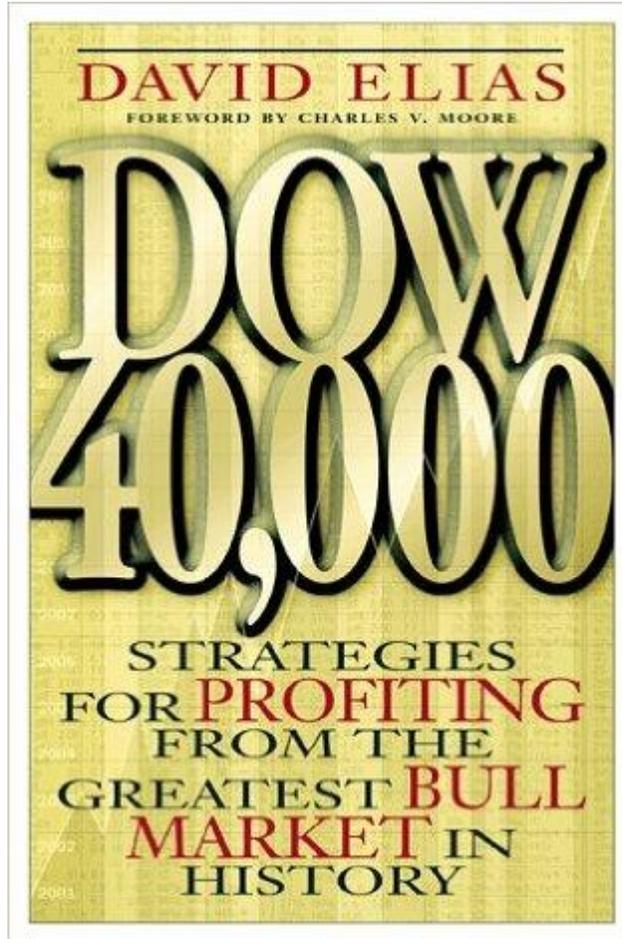
- Rationality of market participants (traders, investors, ...)
- No market frictions (taxes, transaction costs, ...)
- Close to **multivariate normal** (Gaussian) data
- Complete markets
- High (even infinite) market liquidity, ...

**And whereas models can be adjusted for the above, in times of a real crisis also these “better models” would not offer the results as promised in the sales documentation! A main reason for this is the **toxic combination of volume and speed mainly due to non-linearities.****

# RM: Then (3) - early 2000 we **should have learned** about:

- (I)liquidity of markets in times of a crisis
- Highly leveraged institutions, large “AAA”-volumes
- Model uncertainty, model risk, non-linearity
- Non-normality, Extreme events
- Regulatory arbitrage
- Off-balance positions, OTC volumes
- Greed, Non-rationality, Human factors
- **Short-term financing of long-term risks (!!!)**
- Accounting deficiencies
- Global financial networks, systemic risk
- Etc ... etc ... well, **we didn't!**

1999-2000 however saw the appearance of books like:



Financial markets were buoyant, “trees grow into heaven”!

Here is a **quote** from the back cover of the first book:

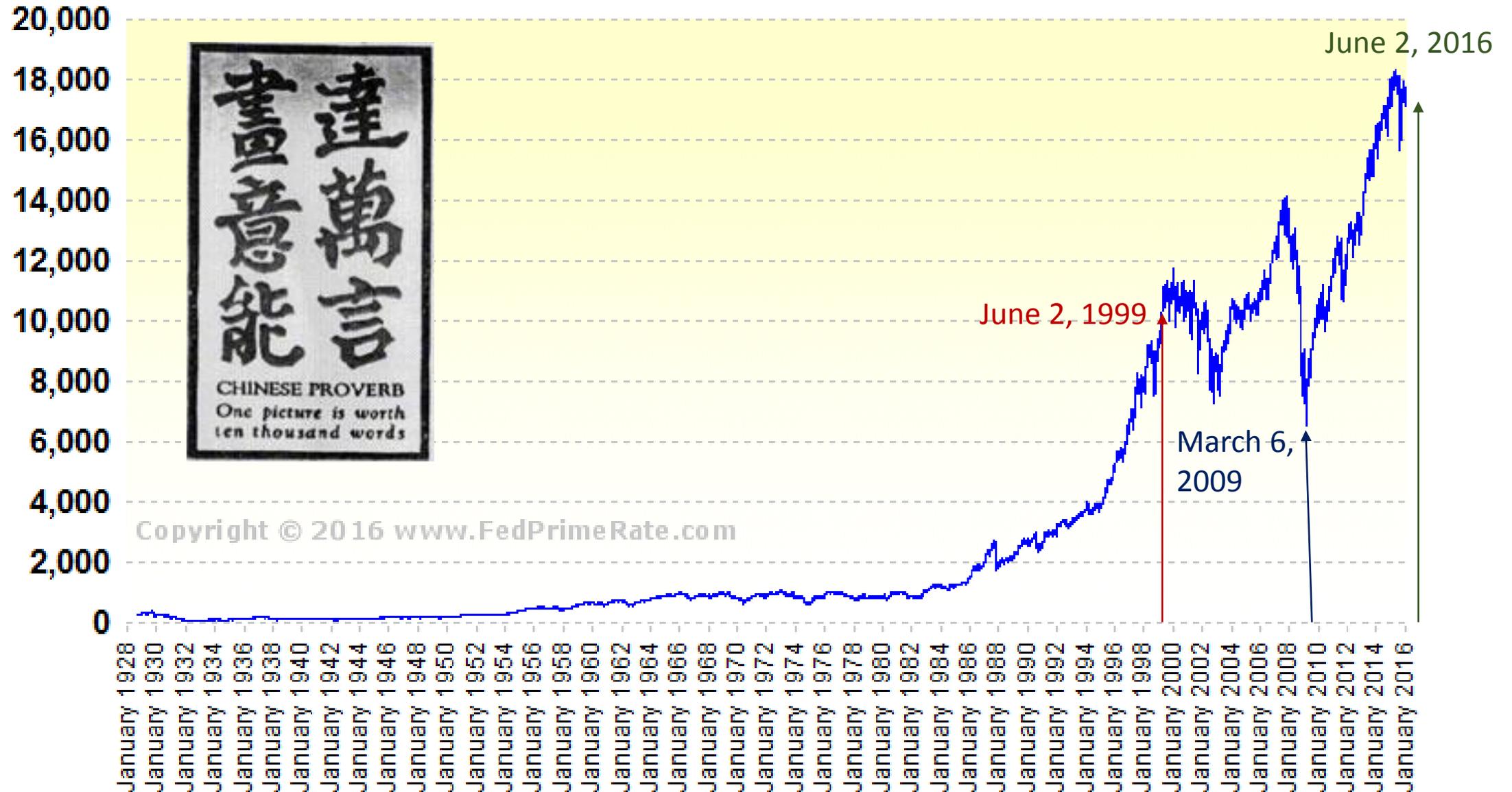
David Elias (**1999!**): “Well-researched strategies to soar with the Dow to 40,000 and beyond! Date: June 2, 2016. Dow BREAKS 40,000! ‘The Dow-Jones Industrial Average, for the first time in history, today **broke through the unthinkable 40,000 barrier**. Leading market experts predict the market will continue to rocket upward.’”

So far for **fiction**, **reality** was that on June 2, 2016 the Dow-Jones stood at **17,838.56**! On June 2, 1999 it stood at 10,577.89 and on March 6, 2009 it hit its lowest value since April 1997 of 6,469.95.

# Dow Jones Industrial Average (DJIA) History

October 1, 1928 Through January 5, 2016

40,000  
↑↑↑



# RM: Then (4) - Basel II and Solvency II: early days

- Early 2000 consultative documents on **Basel II** were mailed around, it was also the learning phase for **Solvency II**
- Basic set-up: a **three-pillar approach** and **Capital Ratio** = “Capital”/RWAs
- Risk categories: Market (MR), Credit (CR), **Operational (OR)** for banks
- **Philosophy: Internal models:** the calculation of **Risk Weighted Assets** through internal models became widely accepted. This led to what I would like to refer to as **Model-Darwinism:**

“Let the best model win”/“The survival of the fittest model”

Initially, **Solvency II** as well as the **Swiss Solvency Test** wanted to follow this route.

The following paper warned early on (2001!) for **regulatory weaknesses** underlying the **Basel II proposals:**

Embrechts, P. et al. (2001): **An academic response to Basel II**  
Financial Markets Group, London School of Economics.

(Mailed as an official response to the Basel Committee and  
published on its website as such) (17 pages)

→ PE website since 2001!

et al. = Jón Daniélsson  
Charles Goodhart  
Con Keating  
Felix Muennich  
Olivier Renault  
Hyun Song Shin



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OF ECONOMICS AND  
POLITICAL SCIENCE ■



# Main findings of this report:

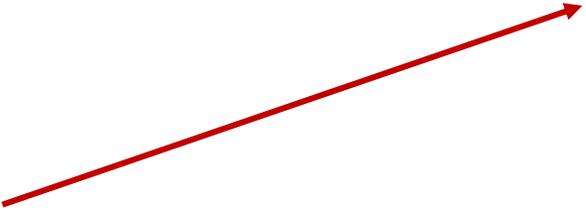
- (1) The **Basel II** regulations fail to consider the fact that **risk is endogenous**, VaR-based regulation can destabilize an economy and induce crashes when they would not otherwise occur.
- (2) **Statistical models** used for forecasting risk typically **under-estimate joint downside risk** (joint losses) of multiple assets.
- (3) A too **heavy reliance on credit rating agencies** for credit risk models.
- (4) These proposals will increase **procyclicality** and hence **systemic risk**.
- (5) **Operational Risk** modeling is not possible given current databases.

**Conclusion:** The Basel II proposals will enhance both the procyclicality and the susceptibility of the financial system to **systemic crises**, thus negating the central purpose of the whole exercise.

**Reconsider before it is too late!**

# RM: Now [2004 - 2016]

A period of increased **regulatory activity**, financial **crises**, political and social turmoil, as well as macroeconomic new-land (persisting **low interest rate** environment)



Well known to Japan since about 1993/4!

# RM: Now (1) – Why (+/-) 2004?

The European **Solvency II** Project can be divided into **three phases**:

Phase 1: 1999/2000-**2003**: the learning phase

Phase 2: **2003**-2008/2009: the framework directive phase

Phase 3: 2008/2009 – 2012/2013: the implementing phase

The **Swiss Solvency Test** (SST) based on **Internal Models**: **2006**

The **Basel II** Accord for banks: **2006**

The **FSA in Japan**: **(1)** “Program for further financial reform” of **2004** and **(2)** “Optimal combination of rules-based and principles-based supervisory approaches” as a main pillar of “**Better Regulation**” (December **2007**) leading towards **(3)** “The Principles in the Financial Services Industry” of **2008**.

# RM: Now (2) – The 2007-2009 Financial Crisis:

For many (even most!), the financial crisis came as a **total surprise!**

Here is an eminent example:

“There is growing recognition that the dispersion of credit risk by banks to a broader and more diverse group of investors, rather than warehousing such risk on their balance sheets, has helped **make the banking and overall financial system more resilient** ... The improved resilience may be seen in **fewer bank failures** and more consistent credit provision. Consequently the commercial banks may be less vulnerable today to credit or economic shocks”

**IMF Global Financial Stability Report, April 2006**

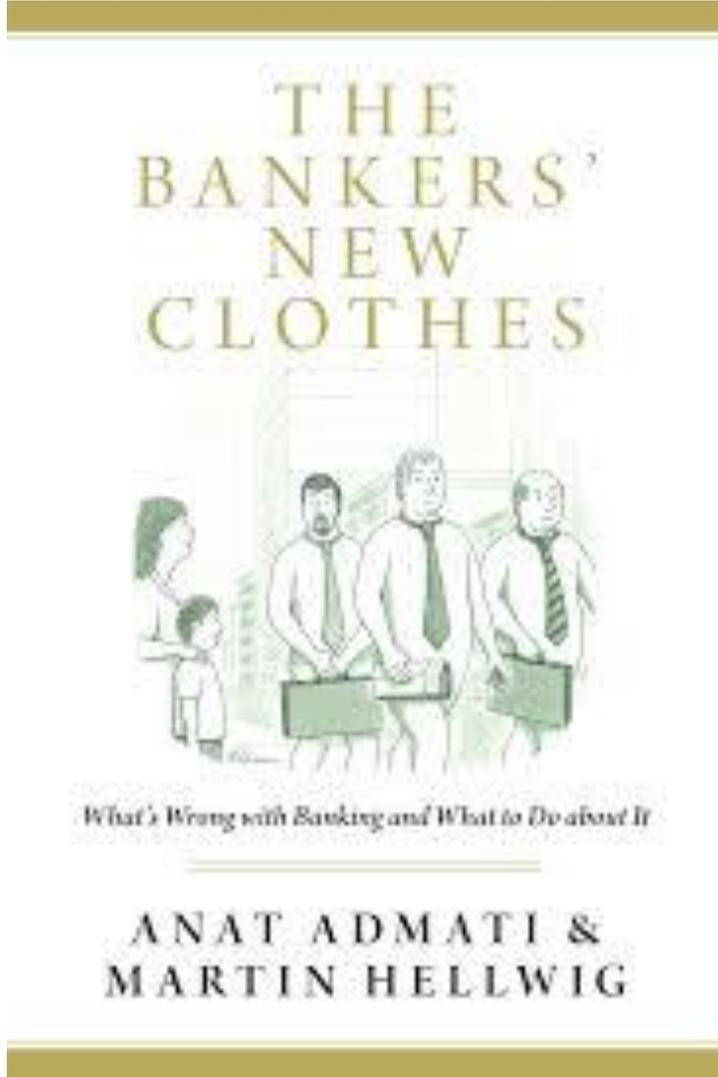
Our 2001 report “An academic response to Basel II” fully **disagreed!**

- As predicted in our 2001 report, the regulatory framework in place was totally insufficient and even exacerbated the **systemic risk** in the global financial system.
- The **insurance industry** was (and still is) not immune for such global financial events, either **directly** by selling protection to financial credit derivatives positions (e.g. AIGFP on CDO and CDS positions) or **indirectly** through their asset side of the balance sheet, or further, as in the case of the life-insurance industry, because of the existence of long-term guarantees and the triggering of embedded options in contracts (here there are many examples, and this **till today**).
- (IAIS 2011) “The **traditional model** of insurance builds on the underwriting of large diversified pools of mostly **idiosyncratic and uncorrelated risks**. Based on such a business model, traditional insurance is unlikely to become a source of systemic risk” ... “... **there is little conceptual reason for life and non-life insurance activities to either trigger or amplify systemic risk.**” **!!! TRADITIONAL !!!**

# RM: Now (3) – Some consequences

- We need to **redefine** the regulatory landscape for **banking** and **insurance** as well as the business model for **banking** (see (\*) →)
- The **pendulum** swings from the use of internal models increasingly back towards less complex **standard models**
- Overall there is a clear **move away from excessive complexity**, and this both at the level of regulatory documents/procedures and products, as well as at the level of company structures
- Several **critical issues** remain, I just name a few, mainly of interest to the **insurance industry**: (1) flexibility of the “traffic light system”, (2) what is a/the risk free rate, (3) the liquidity premium, (4) how to define and aggregate stress scenarios, (5) appropriate time horizons and confidence levels for risk measures in use, (6) extrapolation of the yield curve, (7) matching and volatility adjustments, (8 etc) ...

(\*)



# RM: Now (4) – Market Consistent Valuation (MCV)

- **Concerning Insurance**: It became abundantly clear during the financial crisis that there is no viable alternative to MCV (→ risk-sensitivity (\*\*))
- A **statutory approach** based on historical costs is usually used for tax purposes as well as for defining shareholders dividends and policyholders profit participations (→ stability)
- **(René Schnieper, formerly FINMA)** “It is also argued that risk modelling should be based on **scenarios** rather than on overly sophisticated probabilistic models. Such an approach enables in particular an effective involvement of senior managers in the company's quantitative risk management.” (P.E.) “**Which scenarios?**” (related to ORSA and NAIC)
- An **ideal** regulatory regime would **combine** internal as well as standard models, and look carefully at possible big **differences: EXPLAIN THESE!**
- A **historical digression on MCV** (Philipp Keller, Deloitte, Zurich) (\*\*\*)

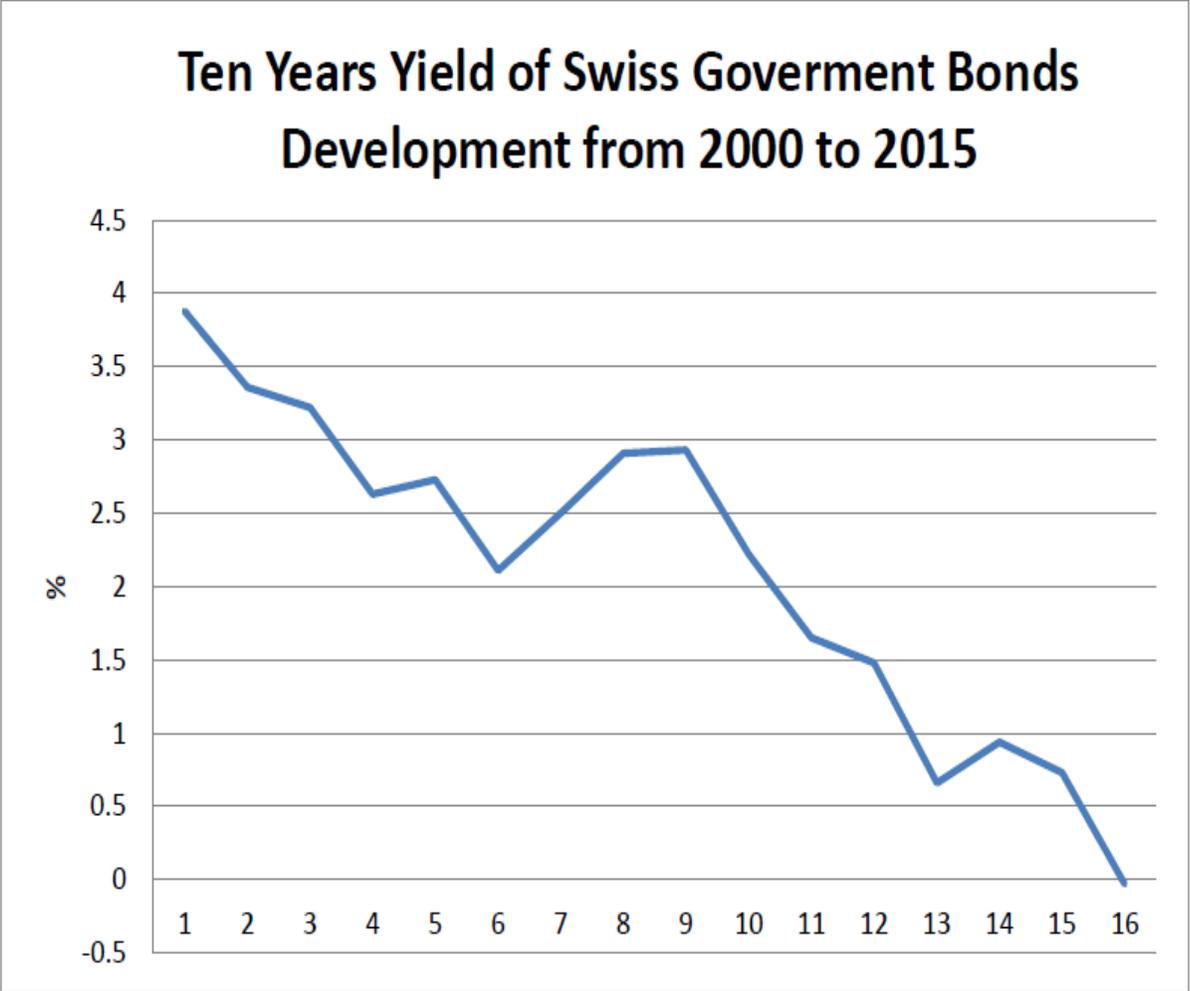
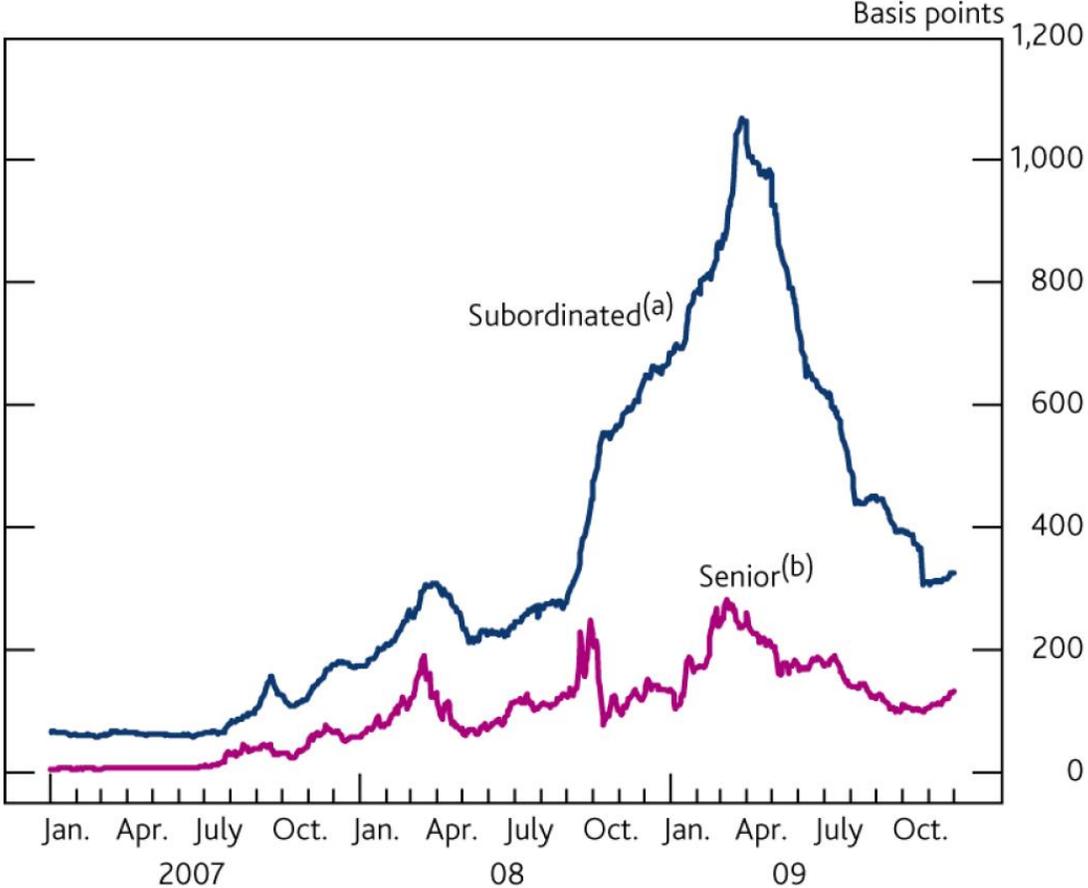
(\*\*) R. Schnieper “Defining principles of a robust insurance solvency regime” (2015)

“It is true that **market consistent valuation leads to a higher volatility** of the solvency ratio than statutory valuation. This volatility however is real. It reflects the situation in the financial markets. It is rather the artificial stability of statutory valuation which deserves to be criticized, since it hides real risks and is therefore not appropriate for solvency testing purposes. This is best illustrated by the development of the **Solvency I ratio** of Swiss life insurers in the recent past as shown in the following table which has been extracted from the FINMA, “Bericht über den Versicherungsmarkt”:

Year:	2008	2009	2010	2011	2012	2013	2014
Ratio:	202%	222%	245%	279%	281%	301%	318%

By looking at the above table **one gets the impression that the credit crisis of 2007, 2008 never took place**. This clearly shows that Solvency I and statutory valuation are **useless** for solvency testing purposes.” ... →

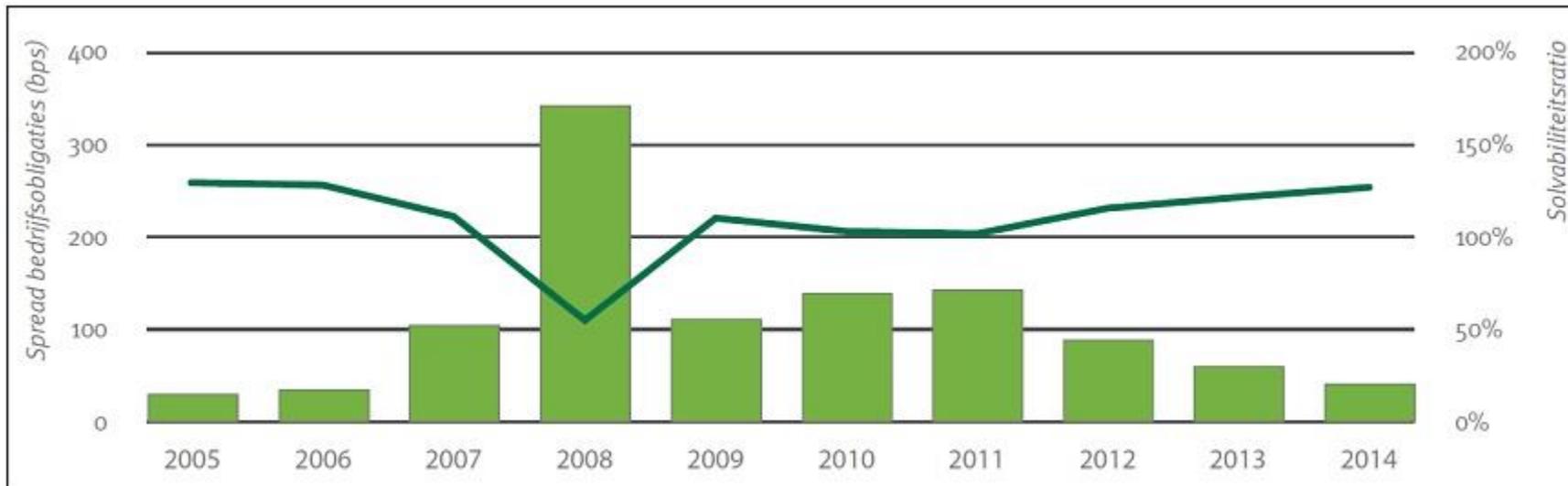
# And this despite:



Exploding bond spreads in 2009 and a dramatic decrease in risk free rate!



Whereas a Solvency II based regulation would yield a result more like:



(Zanders Magazine, 28/7/2015)

Impact of bond credit spread changes (all else being equal) on the solvency ratio of a typical life insurer under Solvency II, had it been in force for the past 10 years.

# (\*\*\* ) Market Consistent Valuation: A long history

❁ 165 ❁

SUR  
LES RENTES VIAGERES,  
PAR M. EULER.

I.  
Ayant établi le véritable principe sur lequel il faut fonder le calcul des rentes viagères, je crois que le développement de ce calcul ne manquera pas d'être fort intéressant, tant pour ceux qui voudront entreprendre un tel établissement que pour ceux qui en voudront profiter. J'ai ébauché cette matière dans mes Recherches générales sur la mortalité & la multiplication du genre humain, où j'ai exposé la juste méthode de déterminer par le calcul, combien un homme d'un certain âge doit payer, pour jouir pendant toute sa vie d'une rente annuelle donnée. Mais, puisque le calcul me paroissoit alors fort embarrassant, je ne pouvois pas me résoudre à l'exécuter. Or une certaine occasion m'obliga dernièrement d'entreprendre ce travail, dont, moyennant quelques artifices pour abrégé le calcul, je suis heureusement venu à bout.

2. Il y a deux choses, sur lesquelles la détermination des rentes viagères doit être fondée: l'une est une bonne liste de mortalité, qui nous montre, pour chaque âge, combien il en mourra probablement pendant le cours d'une ou plusieurs années: l'autre est la manière dont l'entrepreneur peut faire valoir l'argent qu'il aura reçu des rentiers: ou à quels intérêts il est en état de le placer. Ces deux articles concourent très essentiellement à déterminer les rentes auxquelles l'entrepreneur pourra s'engager, tant par rapport à la somme qui lui a été payée d'abord, que par rapport à l'âge du rentier. Car il est évident, que plus l'entrepreneur peut retirer de profit du capital,

X 3

In pricing annuities, **Leonhard Euler (1767)** linked the cash flow of annuities with the return that can be achieved by bonds in the financial market. This is one of the earliest, if not the earliest, explicit **replication approach for pricing and valuing insurance liabilities**.



Originally published as « *Sur les rentes viagères* », *Memoires de l'academie des sciences de Berlin* 16 (1767), 165-175

The eminent Swiss mathematician **Leonard Euler** (1707 – 1783) used to be on the **10 Swiss Francs** (10 CHF) banknote:

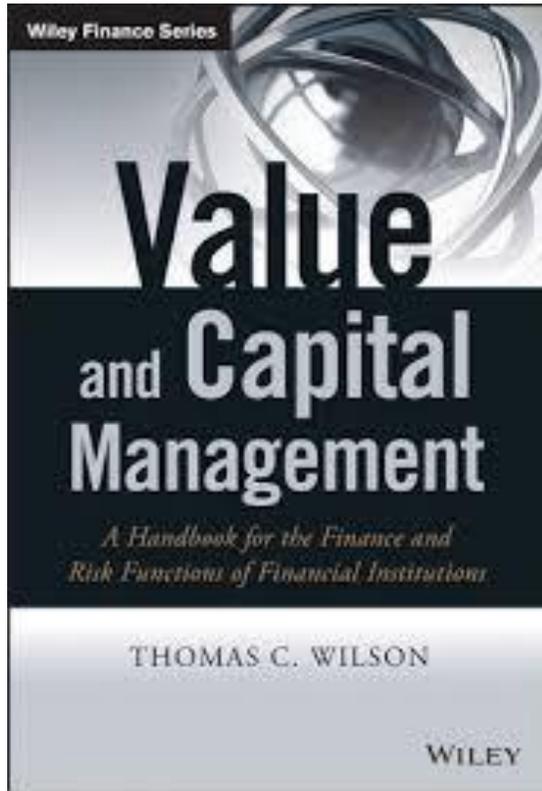


Remark: **capital allocation** in banking and insurance is based on the famous **Euler principle**.

# RM: Now (5) – On systemic (sectorial) risk

- **(R. Schnieper)** “Most insurance supervisors have adequate powers to deal with **individual** insurance companies in a difficult financial condition. The case of a **sectorial crisis** where a large number of insurance companies simultaneously experience extreme financial difficulties is more challenging. In such a market environment, companies do not usually have the possibility to significantly reduce their required capital or to meaningfully increase their available capital. In such a situation, **a relaxation of solvency requirements** by the supervisory authority may be justified. It is argued that such a relaxation should be **temporary, transparent and only apply to legacy business**. It is also argued that, in particular in case of a sectorial crisis, it is important that supervisors have the power to take restructuring measures and if need be to curtail the rights of **policyholders**.”
- **(P.E.)** “Do **not** change the basic principles of principles based regulation but, if needed, **temporarily adjust** some of the underlying parameters.”

# RM: Now (6) – It is all about **value**!



Thomas C. Wilson (2015) CRO Allianz(

“In banking and insurance, risk and capital management and value management are **synonymous**. Accurately **measuring value** is a necessary precondition for **managing** it. ”

## RM: Tomorrow [2016 - ?]

We enter a period of major demographic, political, social and **technological** change and challenges!

## RM: **Tomorrow** (1)

**明日**の事を言うと天井の鼠が笑う

“If you talk about **tomorrow**, the “devil” will laugh at you”  
(Japanese proverb)

“It is difficult to make **predictions**, particularly about **the future**”  
(Mark Twain and many others)

# RM: Tomorrow (2) – Regulation

- **Basel III** (2013), **Basel III ½** and possibly **Basel IV**
- But also **Solvency 2** (2019) and **SST** (life since 2011)
- Similar developments all over the world, including Japan (FSA)
- Tension between **Qualitative** and **Quantitative** approaches
- From Capital Ratios towards **Leverage Ratios**
- The **RWA**-Ansatz needs fixing: Northern Rock, London Whale, ...
- Ring-fencing, resolution plans, living wills, size/complexity limits, ...
- Several **extra** detailed rules and regulations are emerging
- **Complexity**: Glass-Steagall (37 pp.), Dodd-Frank (2300 +++ pp.)
- **Cost-benefit** discussion of increased regulation, ...

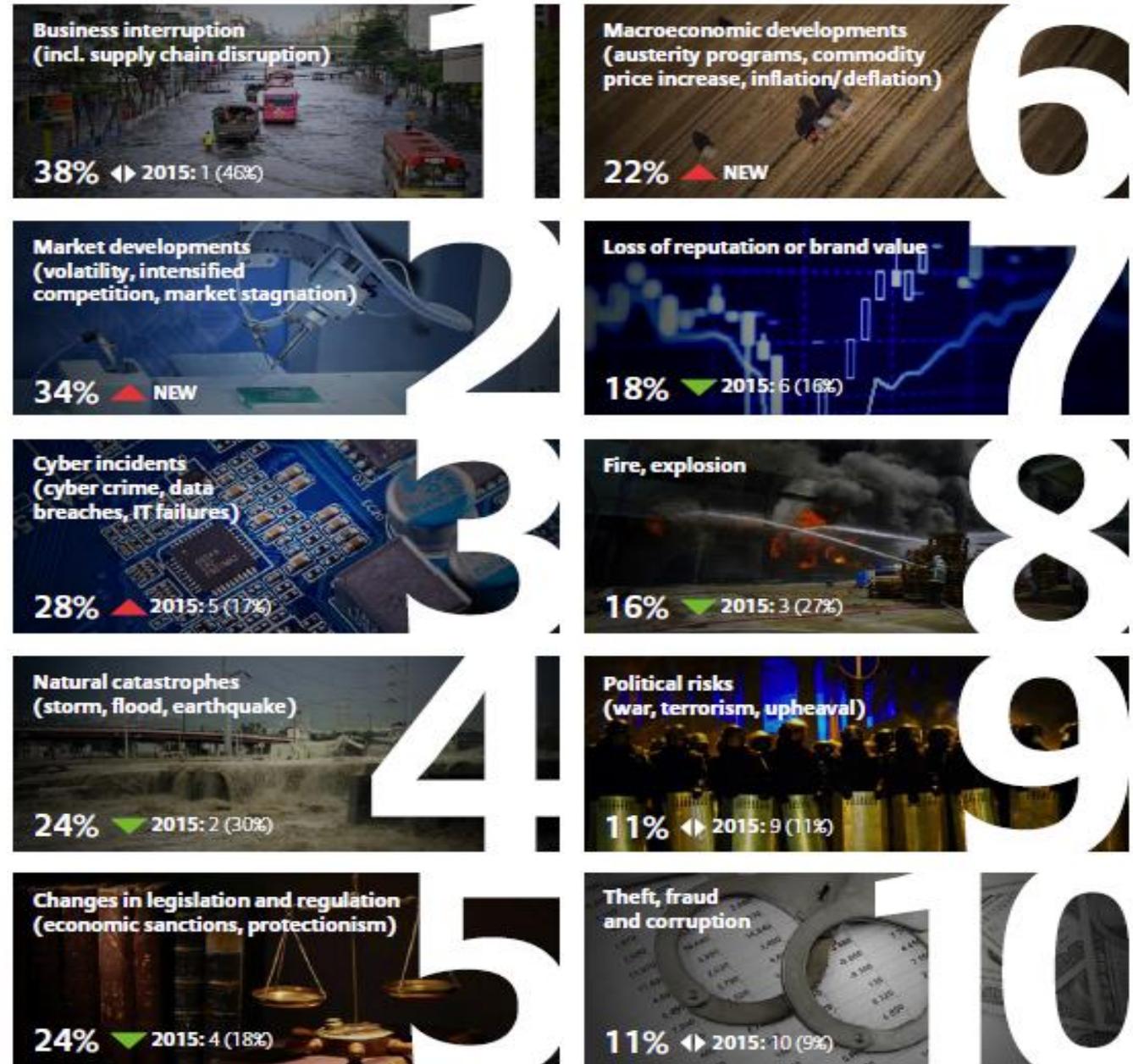
# RM Tomorrow (3) - The Allianz Risk Barometer 2016:

“The fifth annual Allianz Risk Barometer identifies **the top corporate perils for 2016** and beyond, based on the responses of more than 800 risk experts from 40+ countries around the globe. ...

**(1) Business interruption** (incl. supply chain disruption), **(2) market developments** (volatility, intensified competition and market stagnation) and **(3) cyber incidents** are the top three global business risks. Business interruption (BI) is top for the fourth year in succession. “

And hence a **demand** for (re)insurance cover!  
An example of **(1) and (4)**,  
**the 2011 Thai flood ...-->**

## Top 10 Global Business Risks for 2016





- 2011 Thailand flooding
- due to rainfall
- EL 30 bi USD (4<sup>th</sup>)
- EIL 12 bi USD (record)
- Chao Phraya River basin
- 20 mio people (30%)
- Manufacturing industry
- Topography

### Historical records (1985-2012):

- Flood magnitude (7.9): 5th
- Flood duration (158 days): 1st
- 10-20 years return period
- If → What If ...

(a)



(b)



# RM: Tomorrow (4) – The world we (will) live in

- Experiences major geopolitical instabilities and societal crises
- Also: demographic changes, **Social insurance (Life, pensions, health, ...)**
- Economic Terra Incognita: over a long period of time low (even negative) interest rates (Japan!), Euro zone (Brexit!), emergence of China, ...
- **But also: IT-explosion!**
- High-Frequency/Algorithmic trading
- Block-chain technology, crypto currencies ( $\geq 100$ )
- Distributed ledgers, smart contracts
- Big Data (data  $\neq$  information), telematics
- P2P banking/loans (!!! eZubao – China: **7.6 bio \$** Ponzi scheme - **150 bio \$**)
- Shadow banking, shadow insurance, “Facebook banking/insurance”, ...

# RM: Tomorrow (5) – The Actuary of the $n^{th}$ kind

- Actuary of the **first** kind: the **life actuary** (since 17<sup>th</sup> Century)
- Actuary of the **second** kind: the **non-life actuary** (in 20<sup>th</sup> Century)
- Actuary of the **third** kind (Hans Buehlmann, ASTIN Bulletin, 1989)  
for actuaries with skills on the **investment** side of the balance sheet
- Actuary of the **fourth** kind: the ERM actuary (S.P. D'Arcy, Presidential address, November 14, 2005) ← Paul Embrechts presentation
- Actuary of the **fifth** kind: F. Chan & F. Devlin, “B.A.U. for actuaries: **Big data**, Analytics & Unstructured data”,  
[Singapore Actuarial Society Big Data Working Party](#), 3 March, 2016  
→ from the latter reference:

# Actuaries of the Fifth Kind?

Hans Bühlmann  
1987

Actuaries of the  
First Kind

Actuaries of the  
Second Kind

Actuaries of the  
Third Kind

- 17<sup>th</sup> century: Life insurance, Deterministic methods
- Early 20<sup>th</sup> century: General insurance, Probabilistic methods
- 1980s: Assets/derivatives, Contingencies Stochastic processes

Paul Embrechts  
2005

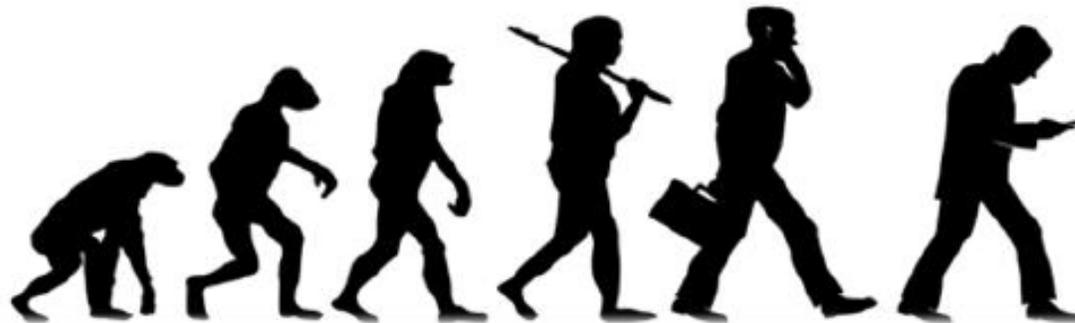
Actuaries of the  
Fourth Kind

- Early 21<sup>st</sup> century: ERM

Big Data  
Working  
Party

Actuaries of the  
Fifth Kind

- Second decade of 21<sup>st</sup> century: Big Data



# Conclusion

- **THE Actuary** typically has (needs) skills **combining** aspects from 1-5.
- Because of kind 5 we definitely have to rethink the actuarial education and research agenda: **Data Science** and its various intersections with IT Technology and Social Networks are having a considerable impact on society at large and hence as a consequence on insurance products needed in this changing landscape.
- In many ways, going from 1 to 5, we are coming back home: the word **actuary** comes from the Latin **actuarius** (+/- 1550s) meaning copyist, account-keeper ... hence surely someone strongly linked and helpful in reaching **business decisions based on data**.
- **Modern society will no doubt need tomorrow's actuary (whether life or non-life) to go back to this early cradle of our profession, that is as a data driven and model guided financial decision maker in a world governed by uncertainty.**

ありがとうございました

Arigato gozaimashita!