Defining Principles of a Robust Insurance Solvency Regime

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The principles relate to the following two topics

- Valuation (available capital)
  - Thesis: for solvency testing purposes one must use market consistent valuation
- Risk Modelling (required capital)
  - Thesis: the probabilistic model used to define Solvency Capital Requirements, should be complemented or even replaced by a suitable set of scenarios

Valuation(1)

There are two fundamentally different valuation methods

- Statutory
  - Based on historical costs
- Market consistent
  - Takes into account all available market information

Valuation (2)

- Market consistent valuation is widely used for solvency testing purposes e.g.
  - Swiss Solvency Test
  - Solvency II (market consistent valuation with relaxations)
- Persistent criticism of market consistent valuation; it is in particular argued that market consistent valuation
  - Is volatile
  - Leads to pro-cyclical behaviour of insurance companies
- Critics therefore claim that statutory valuation
  - Is preferable to market consistent valuation
  - Should be used irrespectively of the purpose of the valuation

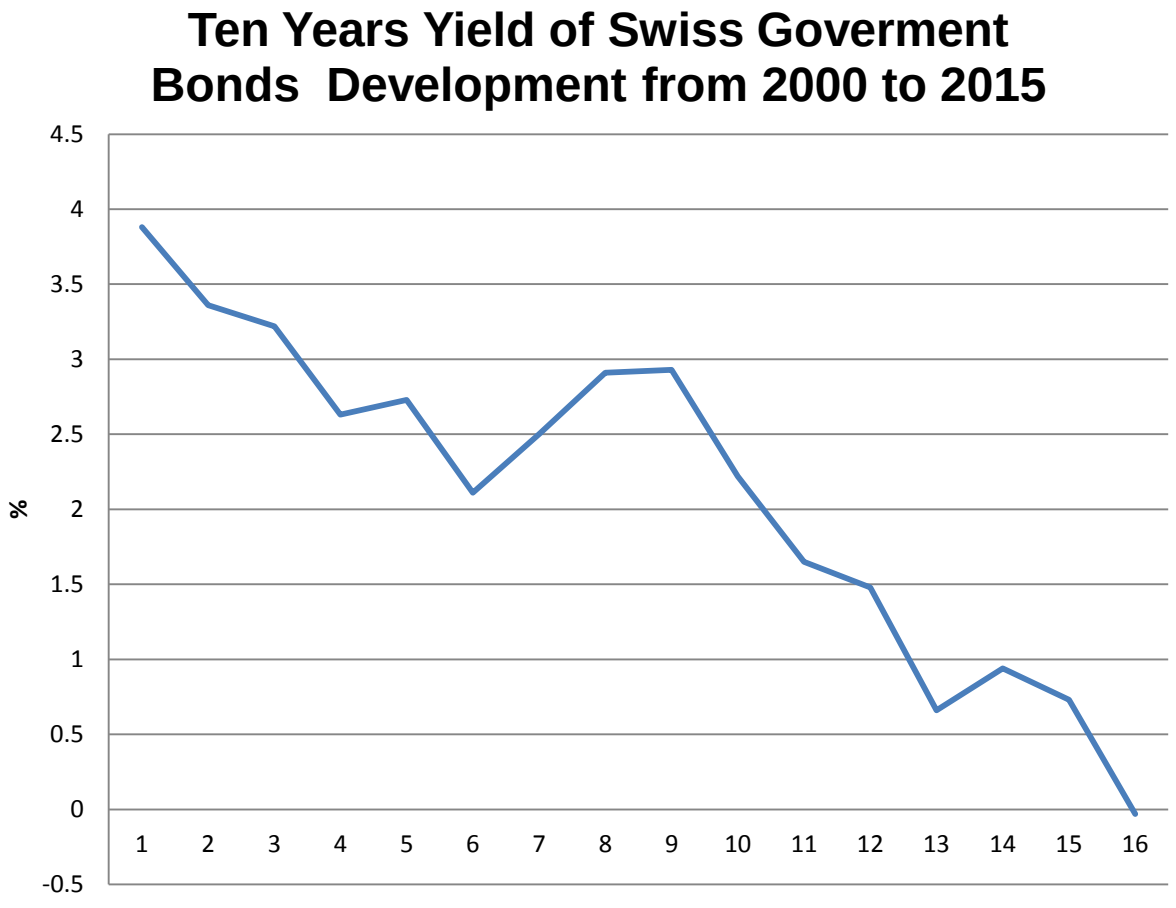
Valuation(3)

- Statutory valuation produces stable results

  Solvency I ratio of Swiss life insurance companies

	2008	2009	2010	2011
S I Ratio	202%	222%	245%	279%

- Steady improvement of the Solvency I ratio over the period (ironically the period starts with the culminating point of the global credit crisis; the steady improvement of the S I ratio is suspect)
- The stability of statutory valuation makes it suitable for assessing dividends, taxes, policy holder participations.. .
- We nevertheless claim that statutory valuation is not suitable for solvency testing purposes


Ten Years Yield of Swiss Goverment Bonds Development from 2000 to 2015
%
4.5
4
3.5
3
2.5
2
1.5
1
0.5
0
-0.5
1
2
3
4
5
6
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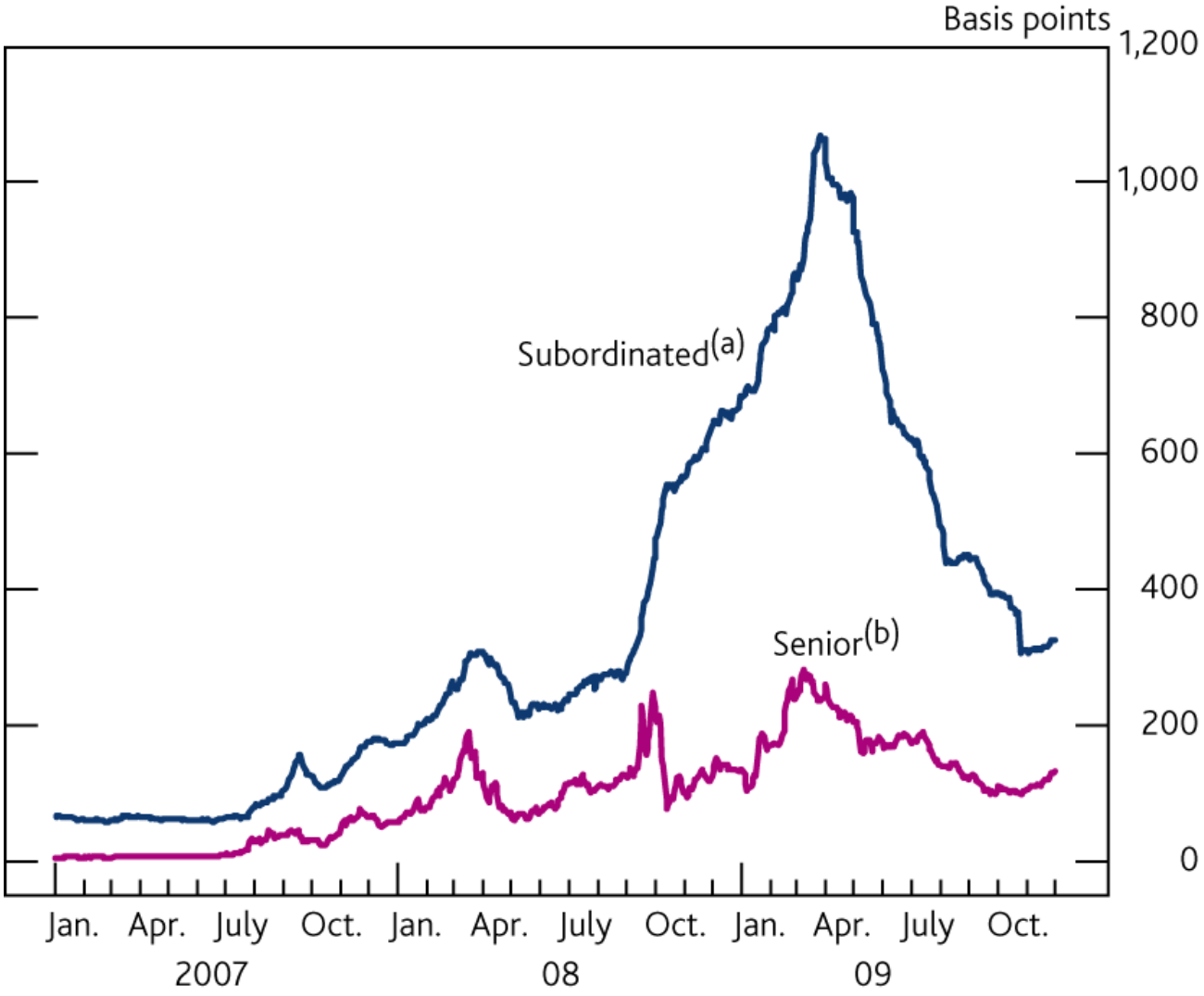
Index of sterling financial debt, published by the Bank of England in its Financial Stability Report of December 2009



Valuation (4)

- There is a contradiction between the dramatic negative developments in the financial markets and the steady improvements of the Solvency I ratio of life insurance companies

- This contradiction is due to the fact that statutory valuation ignores genuine market volatility and hides solvency related problems

Valuation (5)

- What if one nevertheless uses statutory valuation for solvency testing purposes?
  - Solvency related problems of insurers are recognized (too) late
  - Problems can get worse because no supervisory measures are taken; opportunity to intervene at an early stage is missed (capital injection, ban on dividends and policy holders participations, …)
  - Problems can get worse because managers of weak companies take excessive risks (they have strong incentives to do so), make losses and further impair the solvency of companies (Japanese life insurance crisis, S&L crisis)
  - Deficiencies, once recognized, are seen to be much worse than feared; this is a consequence of the necessary switch from statutory to market consistent valuation for restructuring or liquidation purposes (Japanese example from Y 34 bn. to Y 600 bn.)
- Because of its inherent deficiencies , statutory valuation cannot be the basis of a robust insurance solvency regime

Valuation (6)

- Conclusion: in spite of partially justified criticism, one must use market consistent valuation for solvency testing purposes; only on that basis can
  - Solvency deficiencies be recognized at an early stage
  - Supervisory measures be taken at an early stage
  - The interests of the insured be protected

- A word of caution: If market consistent valuation is the valuation standard for solvency testing purposes, the supervisor must have the powers to take restructuring measures
  - The supervisor must have the authority to curtail the rights of policyholders if an insurer is in financial distress
  - If not, the supervisor may be obliged to liquidate insurance companies and sell assets in a distressed market

Valuation(7)
Objections to market consistent valuation

- Volatility
  - Market consistent valuation reflects the genuine volatility of the financial markets
  - Needs some explaining, falling somewhat below the 100% level of solvency ratio is not the “end of the world”
- Pro-cyclicality
  - Market consistent valuation can foster pro-cyclical behaviour
  - Pro-cyclical behaviour typical of investors; sell assets in a declining market because their clients withdraw money, because they have to post collaterals,…
- Possible ways to mitigate pro-cyclicality
  - Dampeners set the wrong incentives and foster instability
  - Counter-cyclical buffers
  - Granting restructuring powers to supervisors

Risk Modelling (1)
General Remarks

- Risk models have become increasingly sophisticated
  - It is difficult for senior management and Board members to truly understand the risk model, to challenge the quants and to properly assess the risk of the company
- Risk models (joint probability distribution function of risk factors) must be selected and calibrated based on very little data
  - Time horizon one year, changes in risk factors are not time homogeneous, relevant data is data from last 5 to 10 years at best
  - rare events (events with an recurrence period of up to 200 years) must be estimated based on 5 to 10 data points
  - Based on the data alone, the true joint probability distribution function of risk factors cannot be reliably estimated (unknown / unknowable)

Risk Modelling (2)
General Remarks

- Choice and calibration of the probabilistic risk model cannot be based on the data alone
  - They must in particular rely on (untested) assumptions about true joint probability distribution function of RF
- What additional sources of information are available?

- Scenarios are a possible remedy; scenarios can be used to complement or replace the probabilistic risk model
- Scenarios incorporate valuable information about
  - What drives changes in risk factors; what are historical extreme changes in risk factors
  - How investors behave, how financial markets work (in a crisis)

Risk Modelling (3)
History of Global Credit Crisis 2007, 2008

- Until 2007, build up of risks, of subprime mortgages and securitisations thereof
- 8/2007 first signs of serious problems with downgrading of different AAA rated securities by several grades at once
- Breakdown of ABCP funding of SIV; SIV taken on parents' balance sheet (originating and servicing banks); capital squeeze of banks
- 8/2007 to 8/2008 relatively slow but steady deleveraging, decline of asset prices, write downs, fire sales
- Repo run on various banks
- 3/2008 funding break down of Bear Stearns; taken over by JP Morgan Chase
- 9/2008 Insolvency of Lehman Brothers (not TBTF)
- Reserve Primary Fund, a money market fund, "breaks the buck"
- Run on money market funds, run by money market funds, run on cash, huge declines in asset prices, not just in mortgage related securities
- Contagion effects on other asset classes
- Flight to quality, downwards shift of risk free yield curve

Risk Modelling (4)

How does this affect the behaviour of investors & changes in RF?

- **Credit crisis triggered by major financial shocks** (insolvency of Lehmann Brothers, Losses at Reserve Primary Fund)
  - Trust evaporates, interbank market dwindles, short term debt markets collapse, SIV have to be taken on parents' balance sheet
- **Investors "run for the exit",** all want to sell the same "risky" assets at the same time; decline in prices of risky assets, write downs, fire sales, **illiquidity**
- Sale of other asset classes, **contagion effects** (MBS, ABS, high yield bonds, corporate bonds, equities,… "Pfandbriefe")
- **"Flight to quality",** everybody wants to buy "safe" assets, treasuries, **downwards shift of the risk free yield curve**
- Because of the **herding behaviour** of investors, the impact on risk factors is much stronger than under "normal circumstances"
  - The herding behaviour leads to much higher volatilities (**tail risk)**
  - The contagion effects lead to much higher dependency between prices and liquidity of different asset classes (**tail dependency)**
- **The "fair weather" risk model becomes totally inadequate**

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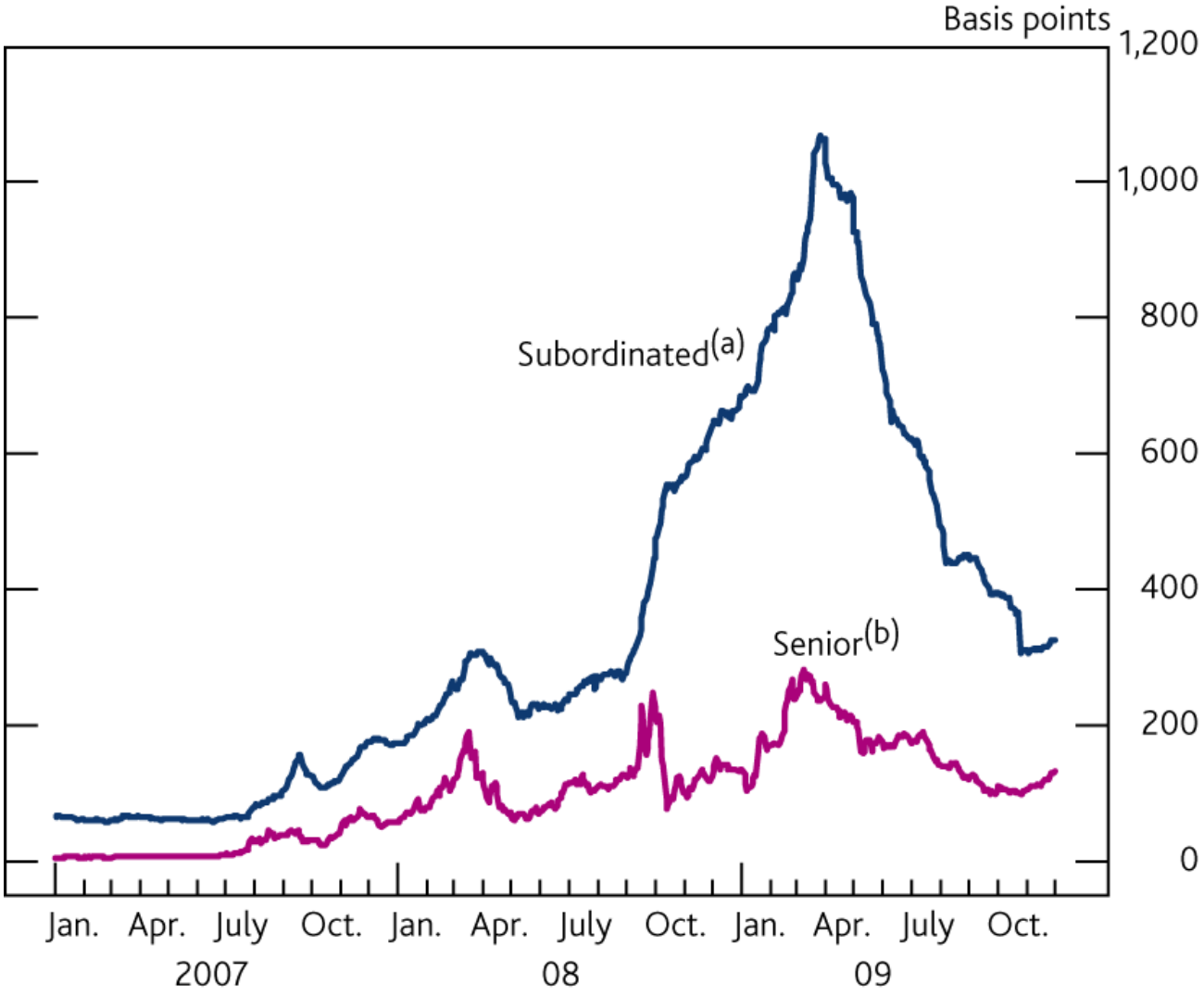

Risk Modelling(5)

How do we take the global credit crisis and other such extreme scenarios into account in the risk model? Two possibilities

- Re-engineer the probabilistic risk model (based on extreme but scarce additional data)
  - marginal distributions,
  - copula

- Change approach
  - Replace probabilistic model by a suitable set of scenarios; introduce scenario based Solvency Capital Requirements

Risk Modelling(6)

Scenario Based Solvency Capital Requirements

- Capital needs of insurance companies are assessed based on a set of scenarios, given by regulator
- The scenarios must be admissible, i.e. scenarios must have occurrence probabilities, at least equal to confidence level of solvency regime
- Thereby the probabilities are subjective probabilities in a Bayesian sense / degrees of belief of experts; there is no need for any probabilistic risk model
- In order to satisfy the Solvency Capital Requirements, a company must be able to withstand the losses from all scenarios (one at a time)
- Solvency Capital Requirement is maximum loss under all admissible scenarios
- Challenge is to find a set of scenarios which is complete, i.e. covers the “main risks” of insurance companies
- We now want to derive a complete set of admissible scenarios for the market risk of insurers

Risk Modelling (7)

Definition and calibration of an individual scenario

- A scenario is defined by its building blocks, i.e. by its elementary stress events, each stress event affecting one risk category
- E.g. in the case of the global credit crisis there are three elementary stress events
  - Dramatic widening of credit spreads
  - Strong downwards shift of the risk free yield curve
  - Strong decline in equity prices
- Calibration of the scenario i.e. changes in risk factors must be such that scenario is admissible
- Calibration is given by experts relying on subjective probabilities (e.g. global credit crisis, panel of experts tells you that an *increase in credit spreads of 300 bps + (BBB bonds), downwards shift of yield curve by 50 / 100 bps + , decline in equity prices of 35% + can occur simultaneously with probability >=0.5%)*
- This defines the changes in risk factors, the calibration of the scenario, and guarantees the admissibility of the scenario

Risk Modelling (8)

- A more structured approach to scenario definition and calibration is provided by Bayesian networks
- One starts with the building blocks of the scenario, the elementary stress events
- One specifies the causal structure between the stress events, e.g.
  - Increase in spreads - > decline in equity prices (causal link due to contagion effects between market segments)
  - Increase in spreads - > downwards shift of the yield curve (causal link due to flight to quality)
- Marginal and conditional probabilities of the stress events are specified
- The joint probability distribution function of the stress events and the occurrence probability of the scenario are derived

Cf. R. Rebonato, Coherent Stress Testing, 2010

Risk Modelling(9)

Derivation of a complete set of scenarios for market risk

- A valuable source of information are historical scenarios and induced changes in risk factors
  - Global credit crisis 2007, 2008
  - Russian debt crisis 1998
  - European sovereign debt crisis, started 2009
  - Global equity crisis 2001, 2002
  - Swiss real estate crisis mid 1990s
  - Recent FX turbulences, strong depreciation of the EUR/CHF 2015
- Advantages of considering scenarios rather than individual stress events
  - Scenarios provide insights into how financial markets work, what drives changes in risk factors, historical extreme changes in risk factors, etc.
  - Scenarios provide a short cut compared to a Bayesian networks based approach; building blocks (stress events) are given, occurrence probabilities are estimated for the scenario as a whole

Risk Modelling(10)

Proposed complete set of scenarios for market risk

Scenario Name	Risk categories affected
Global credit crisis 2007, 2008	Rates, spreads, equities
Revised European sovereign debt crisis (more severe)	Rates, spreads, sovereign debt, bank debt, FX rates
Equity crisis 2001, 2002	Equities
Swiss real estate crisis mid 1990s	Property

- Scenarios are defined by their building blocks (elementary stress events and the risk categories affected)
- Scenarios are calibrated in such a way that they are admissible; changes in risk factors are hypothetical, not historical

Risk Modelling(11)

Derivation of Solvency Capital Requirements for a given company

- Derivation of the SCR based on the scenarios in the complete set of admissible scenarios; SCR is maximum loss under all such scenarios
- Completeness test with possible increase of SCR
  - Comparison of losses from admissible stress events pertaining to a single risk category (equities, property, rates, spreads, and FX rates) with SCR
- Check for specific company vulnerabilities with possible further increase of SCR
  - Focus on the specific positions and vulnerabilities of the given company rather than on the changes in risk factors
  - E.g. Executive Life Insurance Company: high yield bonds
- The SCR of the given company is the result of the three above mentioned steps

Risk Modelling(12)

- The two approaches (probabilistic model and scenarios) can be used in parallel
  - The probabilistic model can be used to define the SCR
  - Scenarios can be used to perform a plausibility test
  - Given the significant uncertainties in risk modelling, using different models makes sense
  - Failing the plausibility test does not necessarily lead to higher Solvency Capital Requirements; it can instead lead to intensified supervision
- Advantages of the scenario based approach
  - Scenarios provide an effective tool to check the quality of internal models and to compare SCR between companies
  - Based on scenarios, senior management and Board members can truly understand the risk model and properly assess the risk of the company