



Market Risk Management in Times of Crisis

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Market risk fundamentals

Toolset before the crisis

Definition

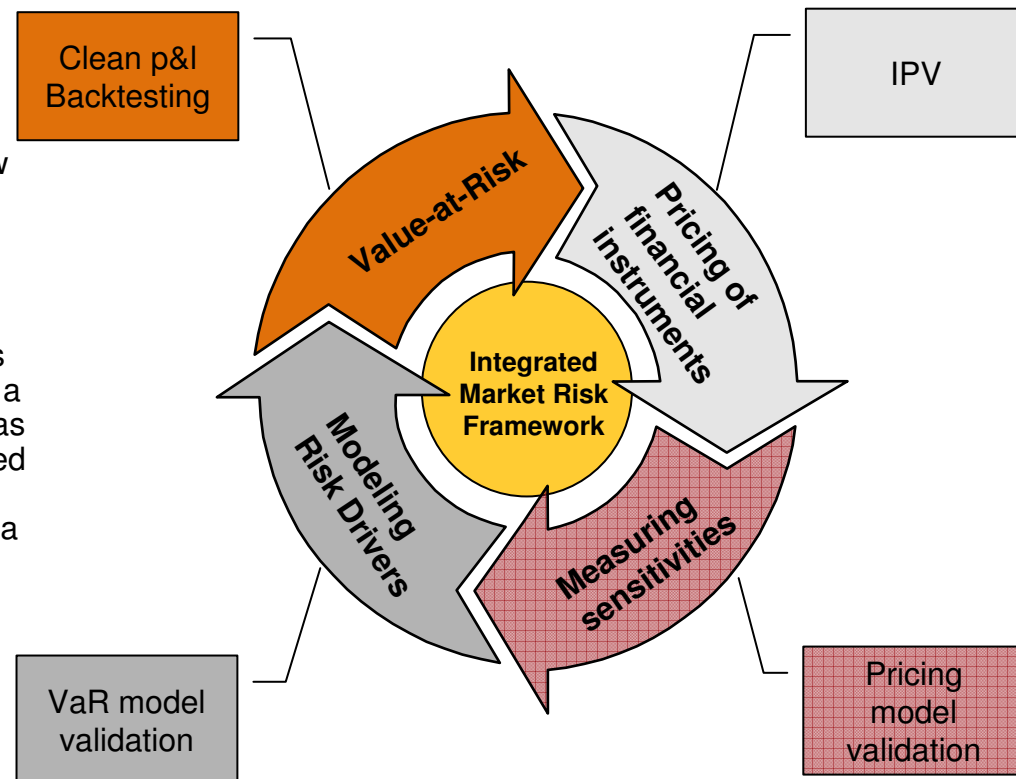
- › Market risks are defined as **potential losses** that can arise when **stock prices, interest rates, credit spreads, fx rates, commodity prices or other pricing parameters** (e.g. volatilities, correlations) **fluctuate**

Quantification of market risks

- › In order to control and manage market risks it is essential to have a concept that transforms market price fluctuations into profit and loss (p&l) figures. **Sensitivities** (i.e. delta, gamma, vega) are the answer to this – they provide exact information how much p&L is generated when prices or rates move to small extents and are useful to estimate p&l impacts for large moves
- › The disadvantage of sensitivities is that they are asset class specific. The solution for an asset class overarching risk figure is **Value at Risk (VaR)**. For a given probability and time horizon, VaR is defined as a threshold value such that the loss does not exceed the VaR figure. For market risk management Commerzbank uses a 97.5% confidence level and a 1 day time horizon

Stress tests

- › VaR is not an appropriate measure for shocks in the market. Therefore market risk management uses **stress test** results in addition to VaR. Thus stress tests and VaR are complimentary analysis tools to assess the extent of potential losses



Market risk fundamentals

Market risk control using limits

Sensitivities

Attributes

- › Asset class specific risk figure (equities, interest rates, credit spreads, fx rates aso.)

Advantages

- › Important risk figure for risk elements that are not in the VaR model
- › Clear information about direction and size of position
- › More intuitive than VaR figures

VaR

Attributes

- › Statistical measure of the maximum loss under given confidence level and holding period
- › Model assumptions are necessary

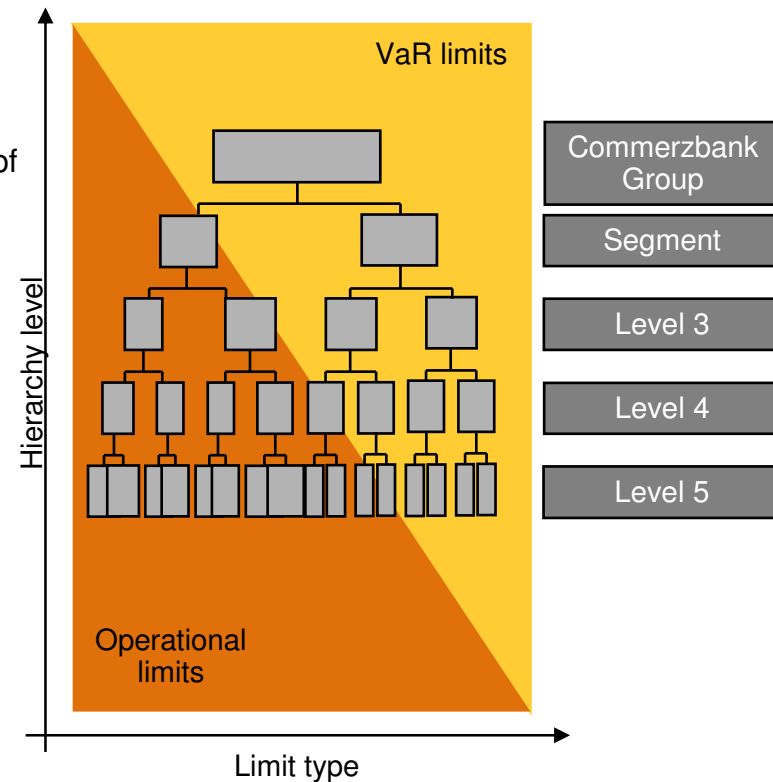
Advantages

- › Asset class and product overarching risk management based on one figure
- › Risk figures adapts to changes in market environment (fluctuations in volatility, correlations)

Result

- › Clearly defined risk appetite

Limits and portfolio hierarchy

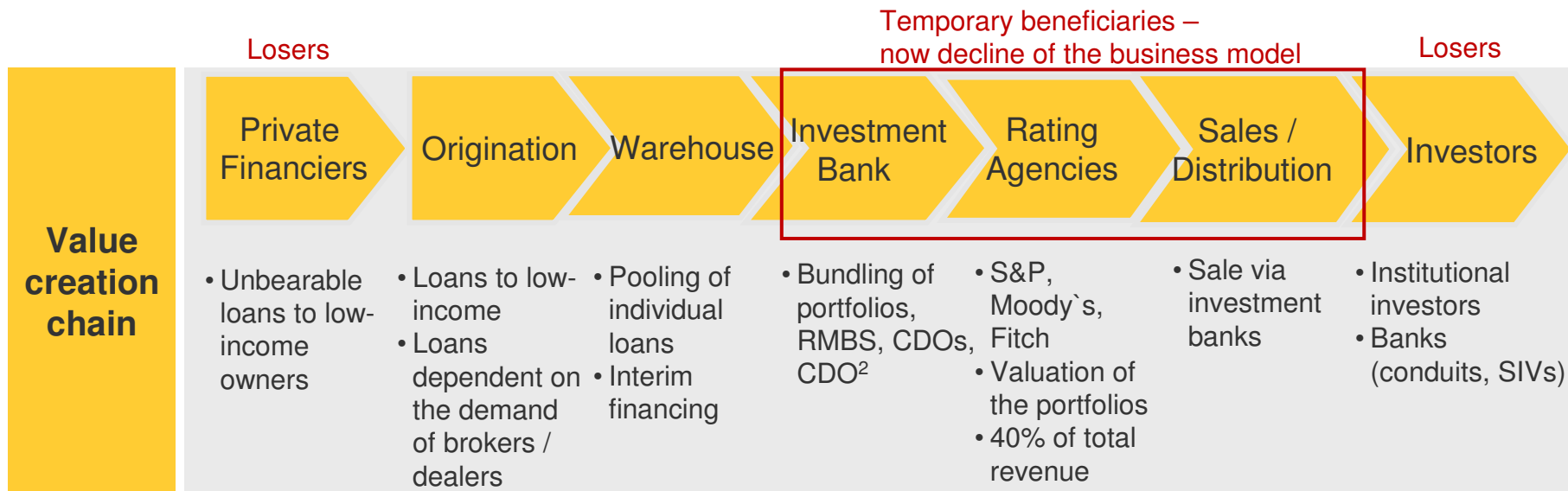


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Main stages of the current crisis

How did it start - Subprime



Cause:

- › Massive increase in the volume of private construction financing to low-income customers
- › Simultaneous strong increase of key interest rates in the USA
- › Increasing defaults due to expiry of the 2-year fixed interest period with Adjustable Rate Mortgages

Main stages of the current crisis

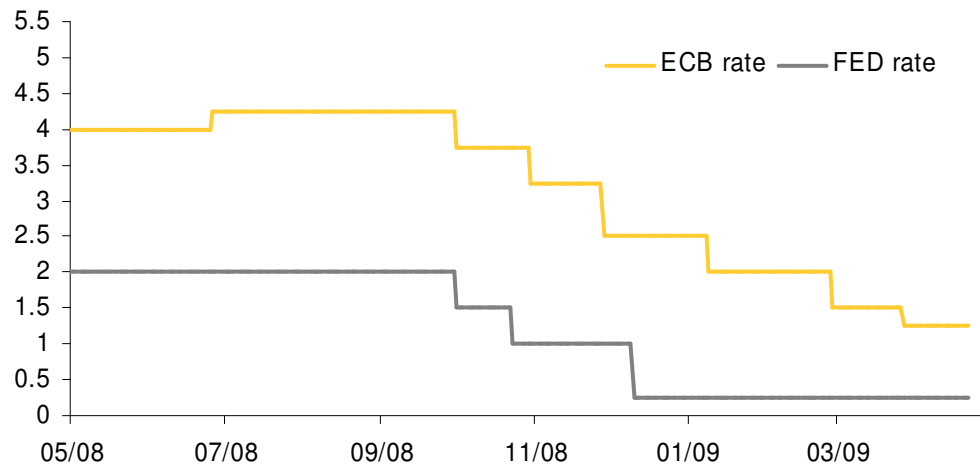
Overview

End of 2006: Beginning of the Subprime Crisis	Since June/July 2007: Closure and liquidation of many hedgefonds, e. g.: May 2008 Bear Stearns: takeover by JPMorgan Chase & Co → Market for subprime mortgages dries out		15th September 2008: Failure of Lehman Brothers „Domino Effect“	October 2008: Iceland: first state close to bankruptcy Eastern and Southern European states are considered critical
	June 2007: Crisis starts to affect the ABS market	September 2007: Liquidity and Funding problems → Central Banks start to decrease fixed interest rates	September 2008: Merrill Lynch: takeover by Bank of America AIG: rescued by US Fed	„Frozen“ money market Capital smelting

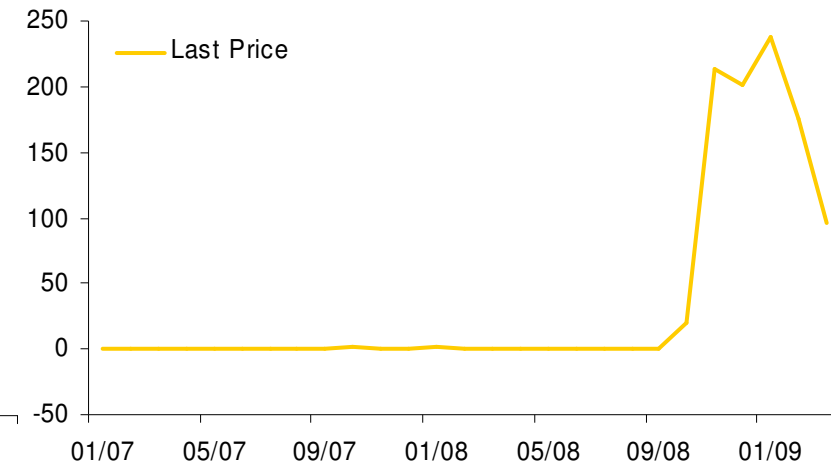
Main stages of the current crisis

Disintegration of the financial markets

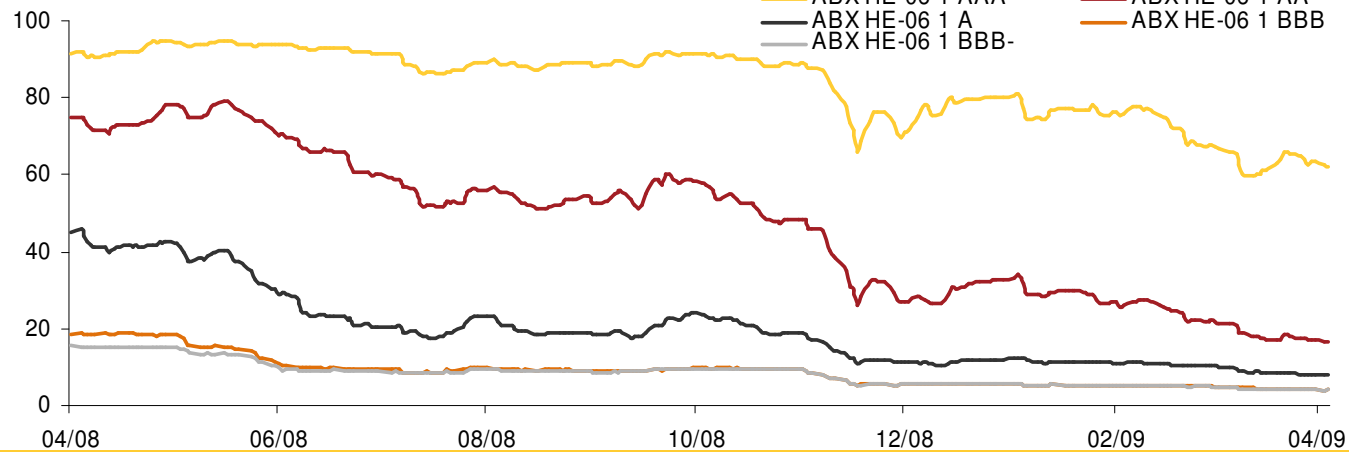
ECB and FED rate
In %



ECB Deposit facility
In bn €



ABX HE 06-1 Index
In bp



Main stages of the current crisis

Further expansion of the crisis to the point of almost national bankruptcies

› Summary of the main further evolvments:

- September 2008: Business model of big investment banks was buried in consequence of Lehman's bankruptcy
- October 2008: world-wide collapse of share prices with Corporates → The financial crisis has reached the real economy
- General situation: all risk types are affected simultaneously by the crisis

› Recent peak of the crisis – States close to bankruptcy:

- Iceland, Eastern and Southern European countries etc
- Potential weak candidates: Romania, Austria, Greece, Spain, Ireland und Portugal

Outlook:



Global recession with an increasing number of corporate and private insolvencies, a sustained fall in property prices and growing country risks!

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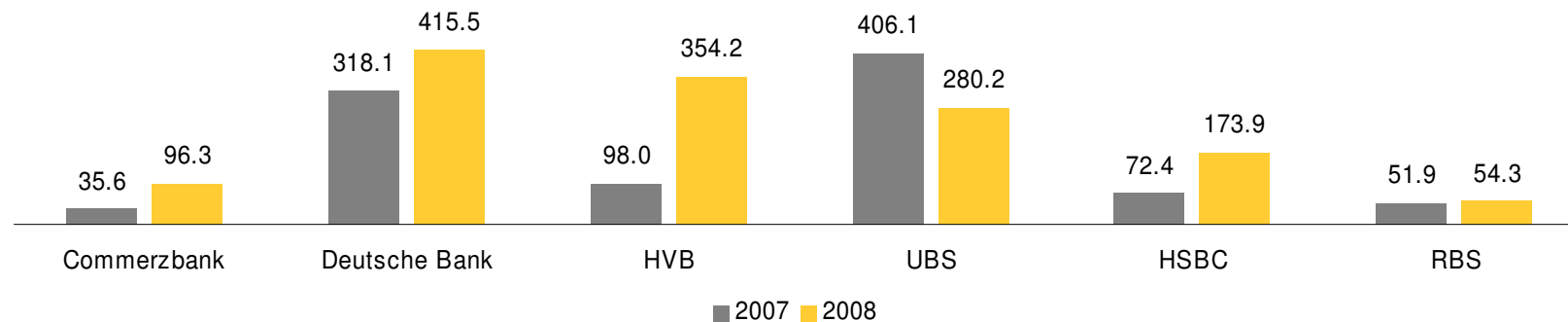
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VaR models, Stress Testing and model reliance

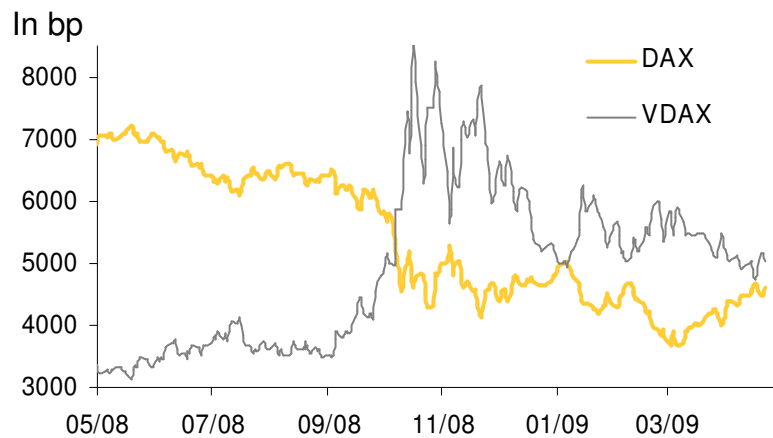
VaR models - Weaknesses

Comparison of VaR for trading book activities

Confidence level of 99% 10 days, in mn €



DAX and VDAX



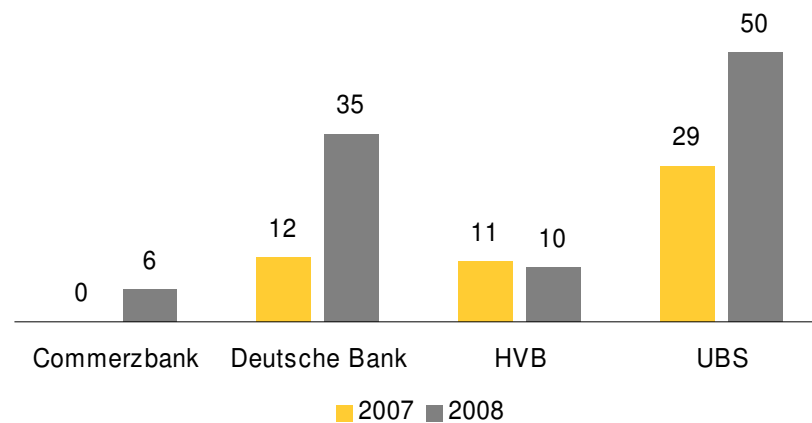
› **VaR-models failed to incorporate strongly increasing volatilities fast enough:**

- Delivery of comparatively low VaR figures
- „Heavy tails“ occurred increasingly

VaR models, Stress Testing and model reliance

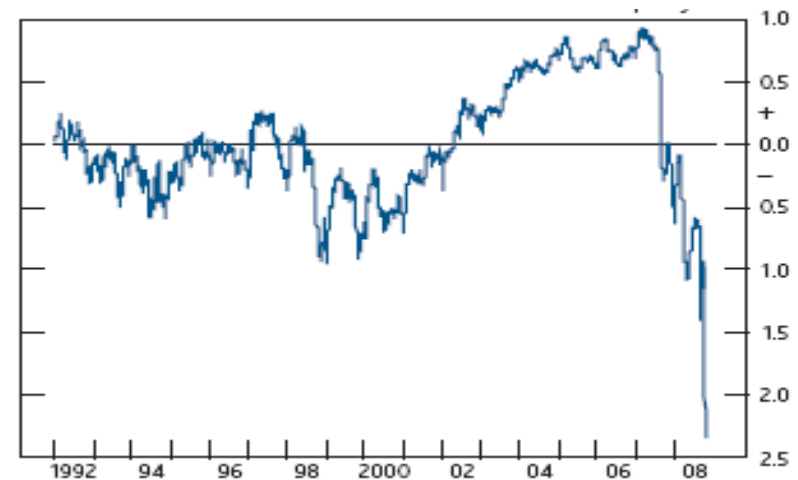
VaR models - Weaknesses

Comparison of Backtesting outlier



Financial market liquidity

Number of standard deviations from the mean



Source: Financial Stability Report (Bank of England) 2008

- › VaR as predictor of potential losses failed
- › VaR presumes that positions always can be liquidated overnight
 - But: dried out market liquidity due to the crisis

VaR models, Stress Testing and model reliance

Stress Testing - Weaknesses

1. Stress testing methodologies

- › Reliance on historical relationships and ignoring reactions within the system lead to underestimation of interaction between risk types (credit, market, liquidity, counterparty and operational risk)

Hedging:

Market risk ↓, but counterparty risk ↑

KfW ↔ Lehman Brothers:

Transfer of 300 million € → operational risk ↑

- › Firm-wide impact of severe stress scenarios were not sufficiently looked at
- › Consequence: Risk managers did not sufficiently...
 - ...question the limitations of traditional risk management models
 - ...take account of qualitative expert judgement to develop innovative ad-hoc stress scenarios

VaR models, Stress Testing and model reliance

Stress Testing - Weaknesses

2. Scenario selection

▶ Standard Stress Tests

Change of one or more **isolated risk drivers** by a fixed amount (e.g. all equity markets down 10%).

▶ Historic Events

The effect of a **past event** is applied to the current portfolio (e.g. 9/11).

▶ Historic Simulation

Calculate the largest loss for today's portfolio using the **market movements of the last 100 days**.

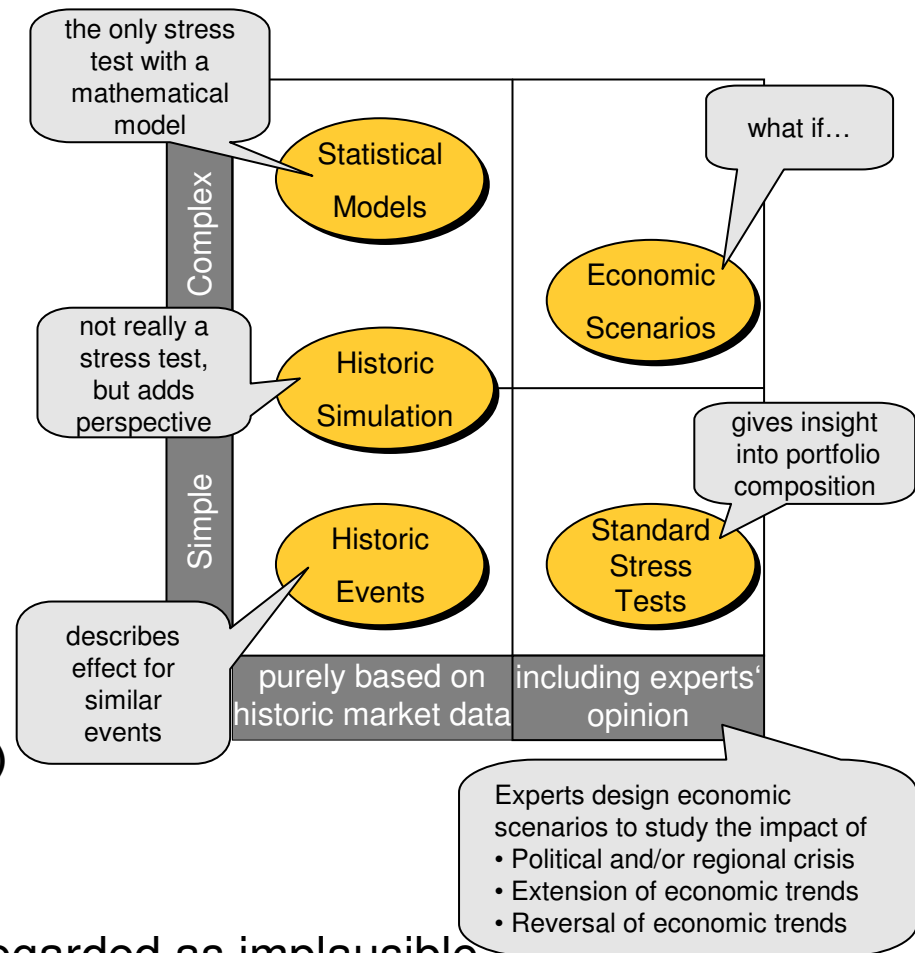
▶ Economic Scenarios

Experts determine **hypothetical scenarios**

- design based on current portfolio composition (e.g. short USD, long JPY; assume adverse market move)
- dependent on hypothetical event (e.g. what would happen if the oil price rises by \$10 in 1 day?)

▶ Statistical Models – Extreme Value Theory (EVT)

Use a mathematical model of extreme events to calculate the maximum loss for a given probability based on a long history of market data.



› Extreme and innovative scenarios were regarded as implausible

VaR models, Stress Testing and model reliance

Stress Testing - Weaknesses

3. Special risks

- › No recognition of different risk dynamics for structured products
- › Underestimation of the pipeline risk
- › No adequate capturing of contingent risks
- › Funding liquidity: no capturing of the systemic nature of the crisis or the magnitude and duration of the disruption to interbank markets

4. Use of stress testing and integration in risk governance

- › Stress testing practices did not foster internal debate nor challenge prior assumptions
- › Negligence of stress testing, now requirement of a comprehensive view

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Lessons learnt from the current crisis especially regarding VaR models and Stress Testing

Value at Risk Models

- › Now: more attention on market liquidity and funding
 - Consideration of longer liquidation periods
- › Increasing supplement of VaR calculations by stress scenarios
 - Serious consideration of extreme market events



From a mainly statistical and mathematical methods-oriented risk management towards a combination of model know-how and macroeconomic expertise!

Lessons learnt from the current crisis especially regarding VaR models and Stress Testing

$$VaR_{new} = \underbrace{VaR_{classical}}_{\text{Stressed VaR:}} + VaR_{stressed}$$

- › **$VaR_{classical}$** : Depends on movements of market data
 - E.g.: A position itself remains fixed and changes only due to market moves
- › **$VaR_{stressed}$** : Dependent on changes in the respective positions
 - E.g.: Historical data of the financial market crisis in 2008 are frozen, but the related position changes

Calculation rule imposed by law: Trivially adding up both VaR types

- › Reason: Lack of confidence in complicated mathematical models, which try to consider extreme market events
 - Consequence: Significant higher amount of equity capital charge
 - But: more confidence and transparency

Lessons learnt from the current crisis especially regarding VaR models and Stress Testing

Market Liquidity Adjusted VaR

- › Focus on holding periods
- › Neutralisation (market risk reduction and protection of P&L) of risk in small tranches at mid-prices under normal market conditions
- › Neutralisation can be achieved by dynamic hedging, static hedging and liquidation of positions

Evaluation of the method

- › Qualitative extension of the standard VaR leading higher VaR for illiquid portfolios
- › Holding periods are subjective:
 - However: Experience of the risk controller ensures meaningful results
- › An additional systemic back testing of Market Liquidity Adjusted VaR is almost impossible

Lessons learnt from the current crisis especially regarding VaR models and Stress Testing

Stress Testing:

- › Constantly reviewing scenarios and coverage of a range of scenarios:
 - Forward-looking scenarios: What can happen next?
 - Rely more on expert judgements
- › Coverage of complex and bespoke products

- › Improving the identification and aggregation of correlated risks across books as well as the interactions between market, credit and liquidity risk:
 - Delivery of a complete picture of firm-wide risk

Lessons learnt from the current crisis especially regarding VaR models and Stress Testing

Stress Testing cont'd:

- › Evaluating appropriate time horizons and feedback effects
- › Integral part of the overall governance and risk management culture
- › An actionable stress testing
- › Enhancement of internal and external communication : Transparency



- › **Forward-looking macroeconomic valuation**
- › **Strong interaction between market events and its effects during an economic downturn**
- › **Combination of model-know-how and expertise**



Thank you for your attention!

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