Private Sector Risk Applications

Exploring Commonalities to Systemic Risk Surveillance

Dr. Michael Zerbs
President and COO

May 2010

Algorithmics

The Challenge

"Paulson says he was scared and clueless during Lehman collapse."

Chicago Tribune, Feb 1, 2010

"The crisis highlighted the inadequacy of many firms' infrastructure in supporting the broad management of financial risks. Significant gaps remain in firms' ability to conduct firm-wide stress tests."

Senior Supervisors Group, Oct 2009

The Way Forward

"A practical way to estimate institutions' interconnectedness and their corresponding contribution to systemic risk is required."

IMF, April 2010

"Firms should eschew the silo approach and analyze group-wide risks on an aggregate basis, integrating strands such as credit, market, operational, liquidity and reputational risk."

IIF, July 2008

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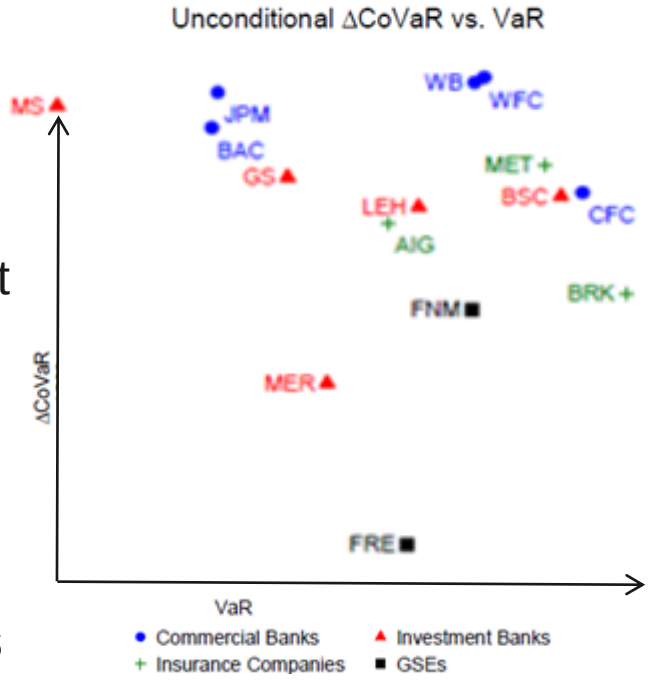
Why Measure Systemic Risk?

Firm-specific ≠ Systemic Risk

Pareto efficiency requires full information

Therefore …

- New macro-prudential frameworks complement established micro-prudential ones
- “Intrusive” regulatory approaches replace “principles based” models
- Centralized ERM can produce better outcomes than decentralized RM



Source: Adrian and Brunnermeier (2009), CoVaR

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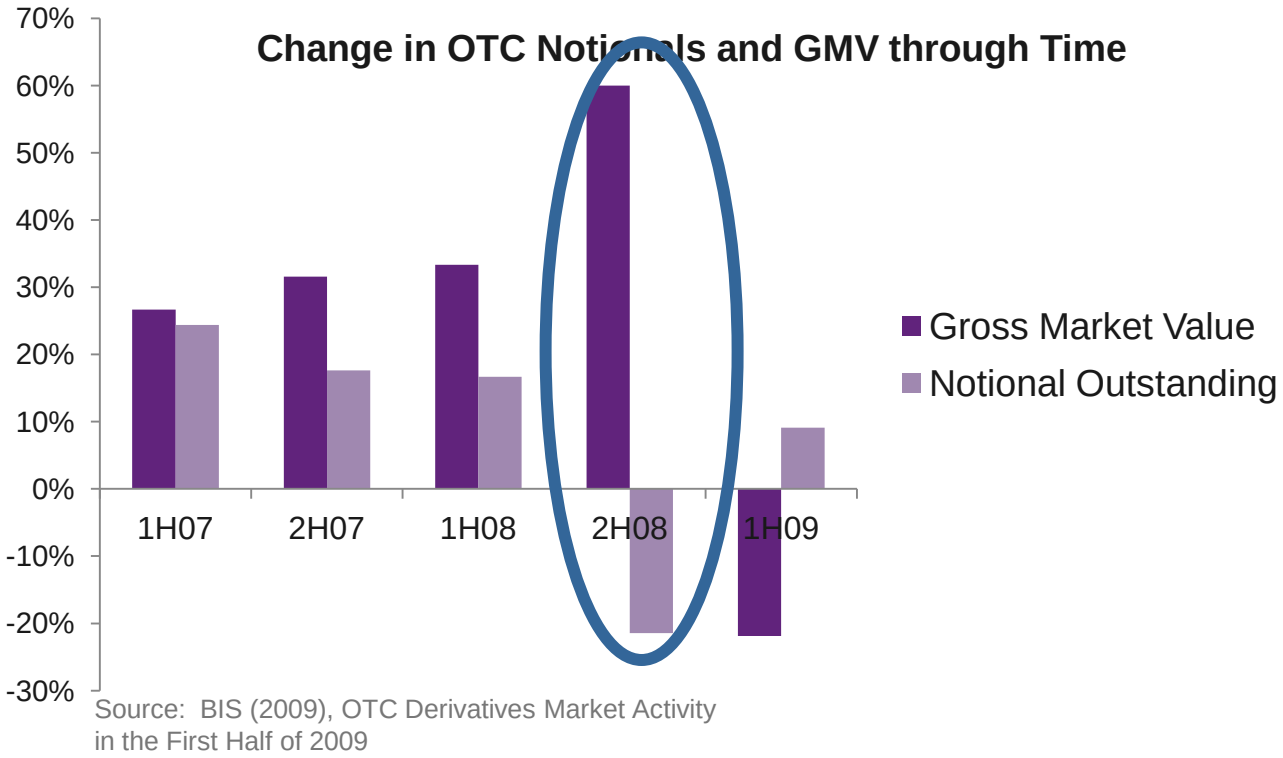
Measuring Systemic Risk

Objectives

- Provide early warning signals
- Assess consequences of stress scenarios
- Determine appropriate systemic risk buffers
- Understand impact of pro-active mitigation and specific interventions
- Timely and actionable analysis

Why Full Simulation? A top-down View

2008: Out-of-the-money puts on Black Swans moved into the money



Source: BIS (2009), OTC Derivatives Market Activity in the First Half of 2009

→ Exposures are non-linear exactly when it matters!

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Why Full Simulation? A bottom-up view

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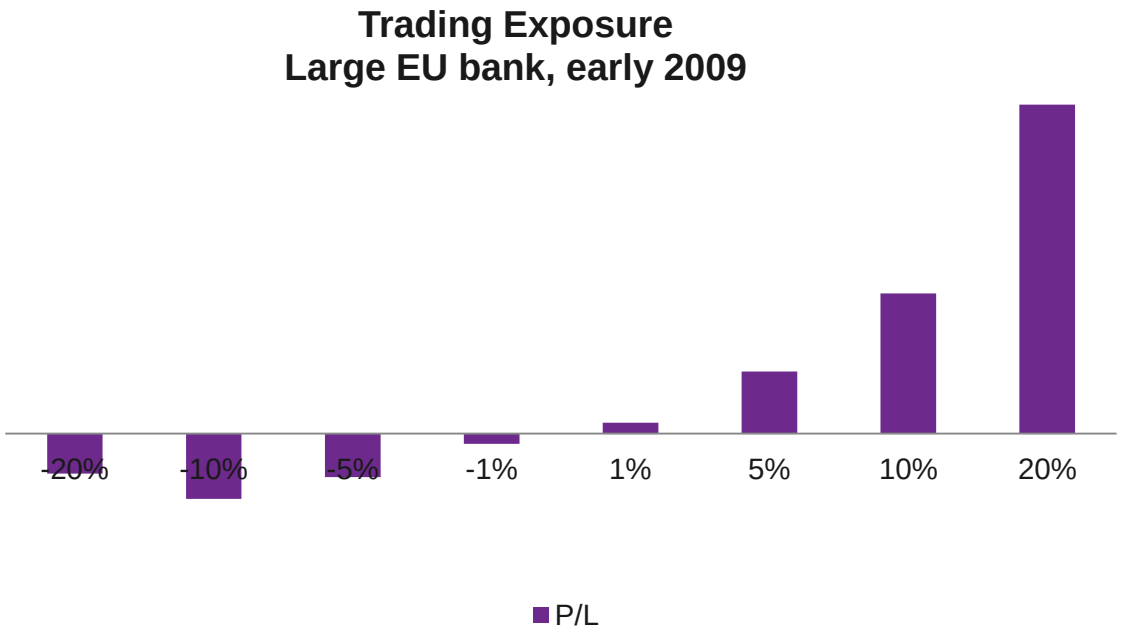
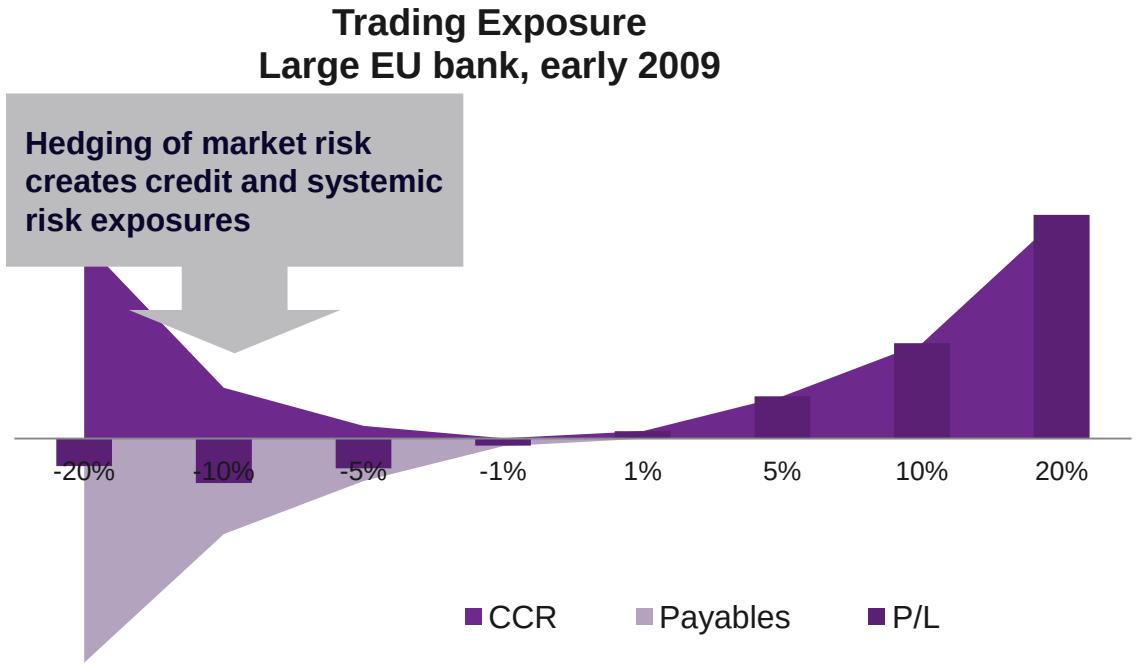


Why Full Simulation? A bottom-up view

2008: Out-of-the-money puts on Black Swans moved into the money



- Market risk factors have material impact on size of systemic risk, e.g. Cont (2009)

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More Non-linearity: Market and Credit Risk

Basel 2009

"In certain portfolios market and credit risk are related in a non-linear way. Since this means that they are inextricably linked, conventional approaches that estimate each risk type separately and then aggregate them (such as 'top-down' approaches'), which are widely used in the industry, may lead to sizable biases. […] An integrated bottom-up approach may be able to avoid [such] biases."

Examples

Foreign currency loans, adjustable rate loans, OTC derivatives, credit transfer, …

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Conceptual Approach to Systemic Risk Simulation

Central simulation platform for all systemically relevant firms

1. Position details (T&Cs, risk factors) and credit hierarchies for firms

2. Extensive stress testing / simulation of risk factors to assess strength of each firm and determine direct implications (e.g. default, specific responses) by scenario and through time
   - Market risk
   - Credit risk (non interbank obligors)
   - Liquidity risk

3. Network model to assess contagion effects across firms by scenario, based on interbank exposures

Potential implementation approach discussed in latest GFSR

Similar framework implemented e.g. at Bank of Mexico

Algorithmics used within (1) and (2)

Algorithmics

Conceptual Approach to Systemic Risk Simulation

Firm D: Positions and
Firm C: Positions and
Firm B: Positions and
Firm A: Positions and instrument T&Cs

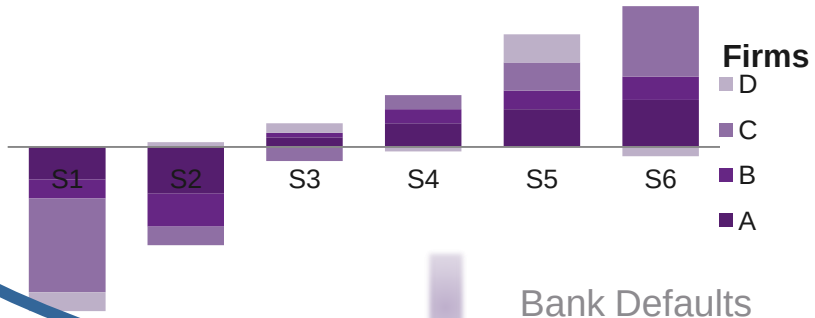
Market & Risk Factors

Scenario Model

M + C Scenarios

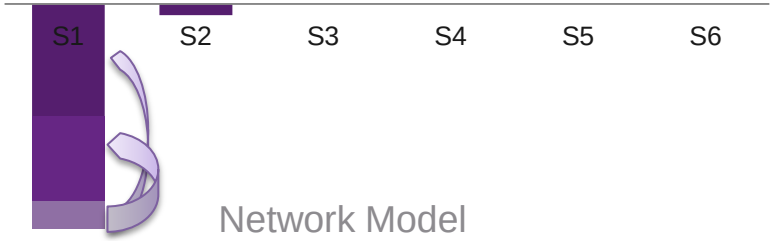
Integrated Simulation

CFs, P/L, CCR, … by Firm and Scenario



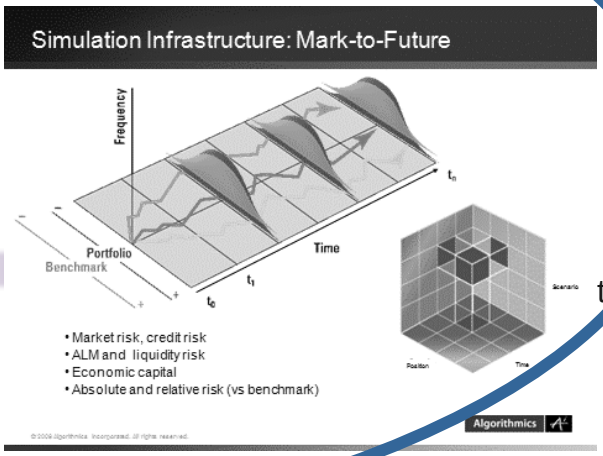
Bank Defaults

Cascading Default Losses

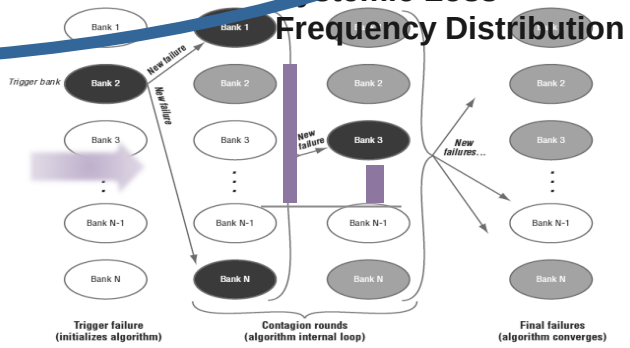


Network Model

Private Sector ERM Applications



Systemic Loss Frequency Distribution



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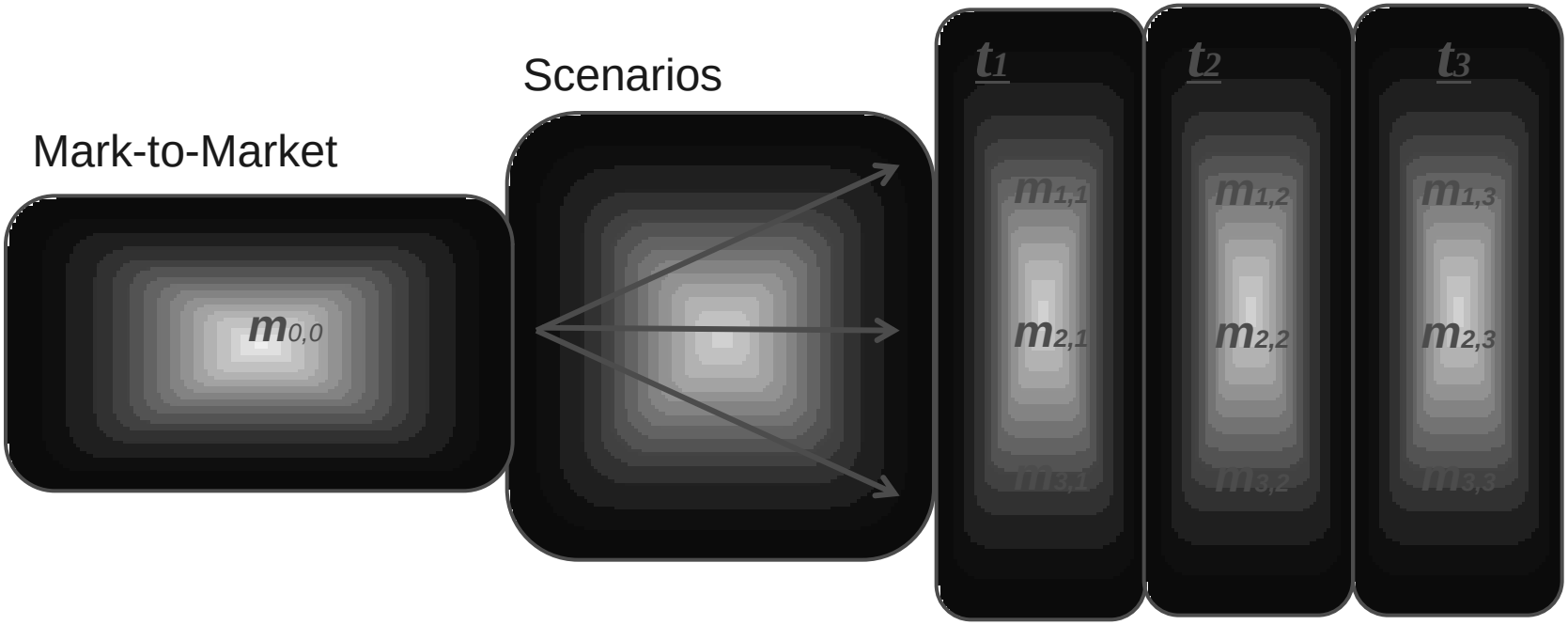
Scenarios Are the Language of Risk

Consider a single financial instrument…

Mark-to-Future:

Value, cash flow, income …



The choice of scenarios defines the relevant risk strands

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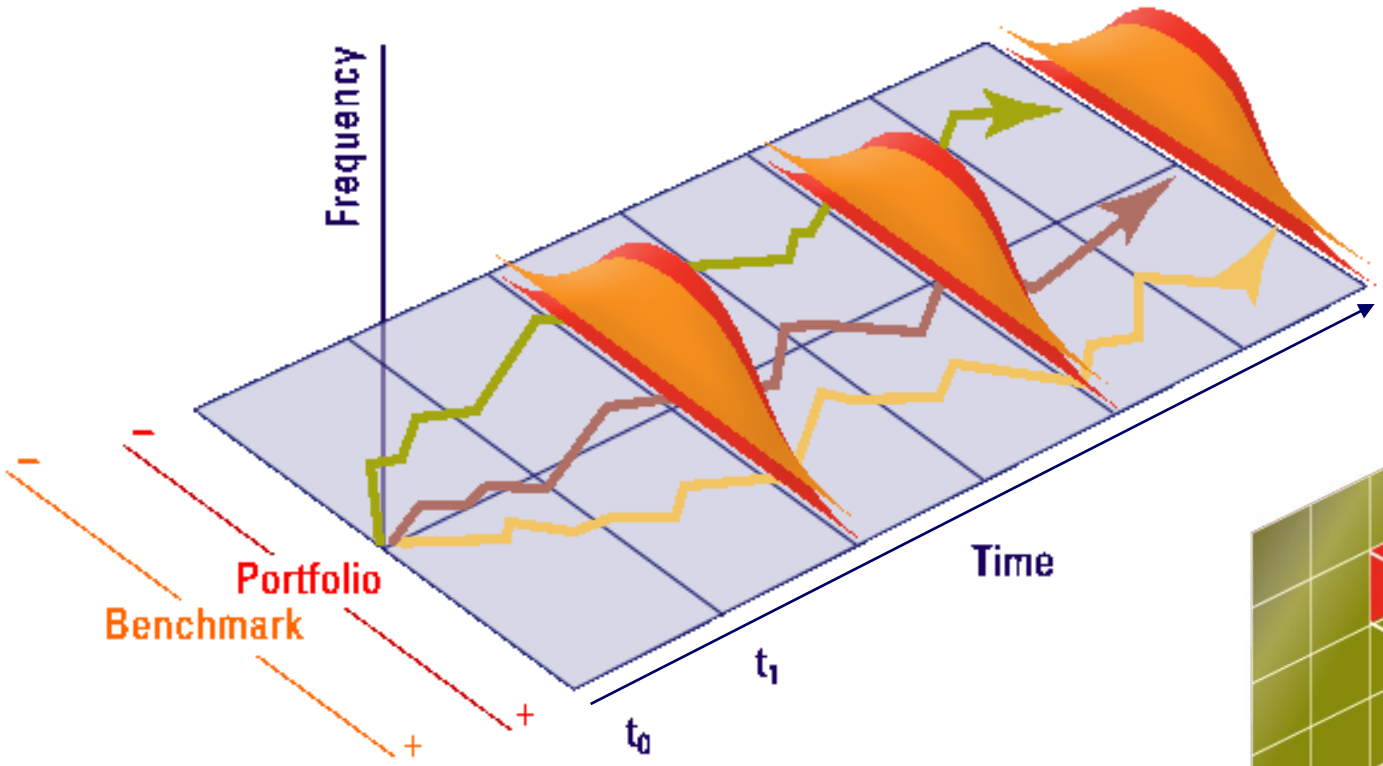
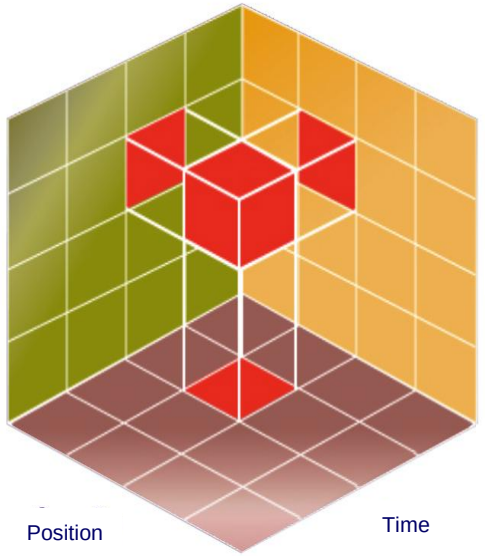
Generalized Simulation Platform: Mark-to-Future





- Market, credit, liquidity risk
- Risk capital
- ALM, capital and liquidity management
- Absolute and relative risk (vs benchmark)

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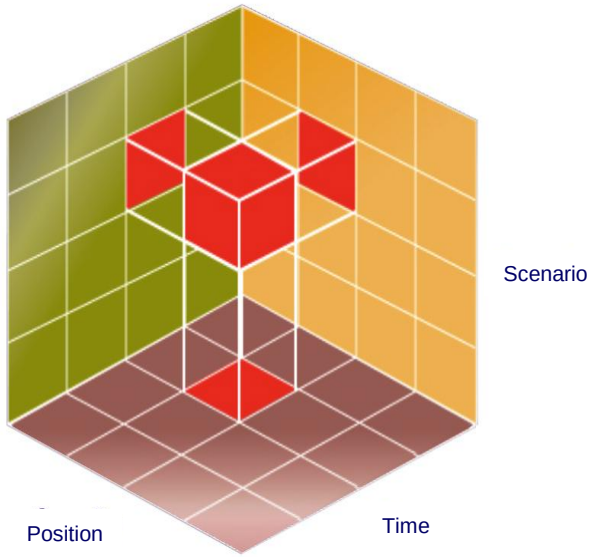
Leveraging Mark-to-Future

Dynamic balance sheet modeling

- Evolve positions through time, conditional on:
  - Risk factor realizations by scenario
  - Portfolio or position characteristics at T or T-n
- Management objectives (funding, target ratios …)

Scenario optimization

- Determine hedge portfolios
- Design benchmarks and allocation strategies
- Price non-market assets or liabilities



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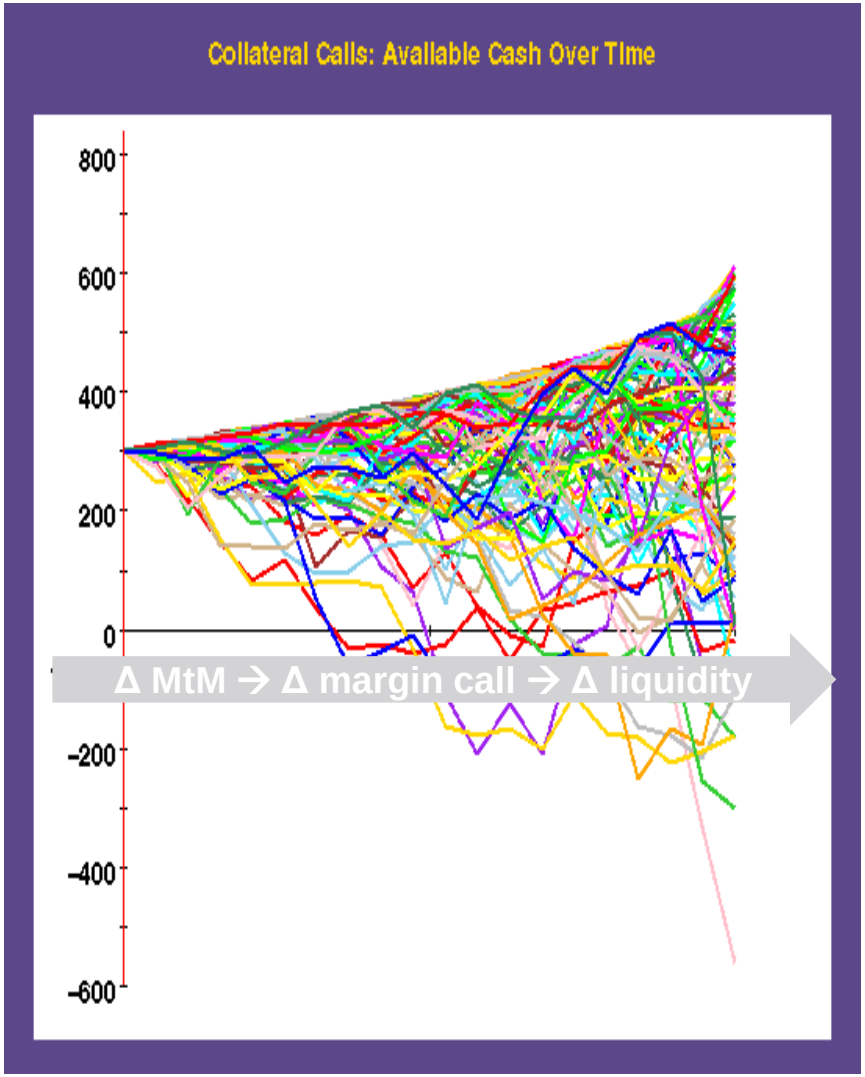
Mark-to-Future: Stress-testing Funding Liquidity



AIG, Enron …

Liquidity coverage ratio must include contingent liquidity needs due to downgrade triggers or potential value changes of derivatives or their collateral

(Basel, 2009)

CCPs may result in additional 'pro-cyclical' margin calls

Critical mass of OTC transactions shifting to CCPs may require around $200 billion *in normal markets*

(Singh, 2010)

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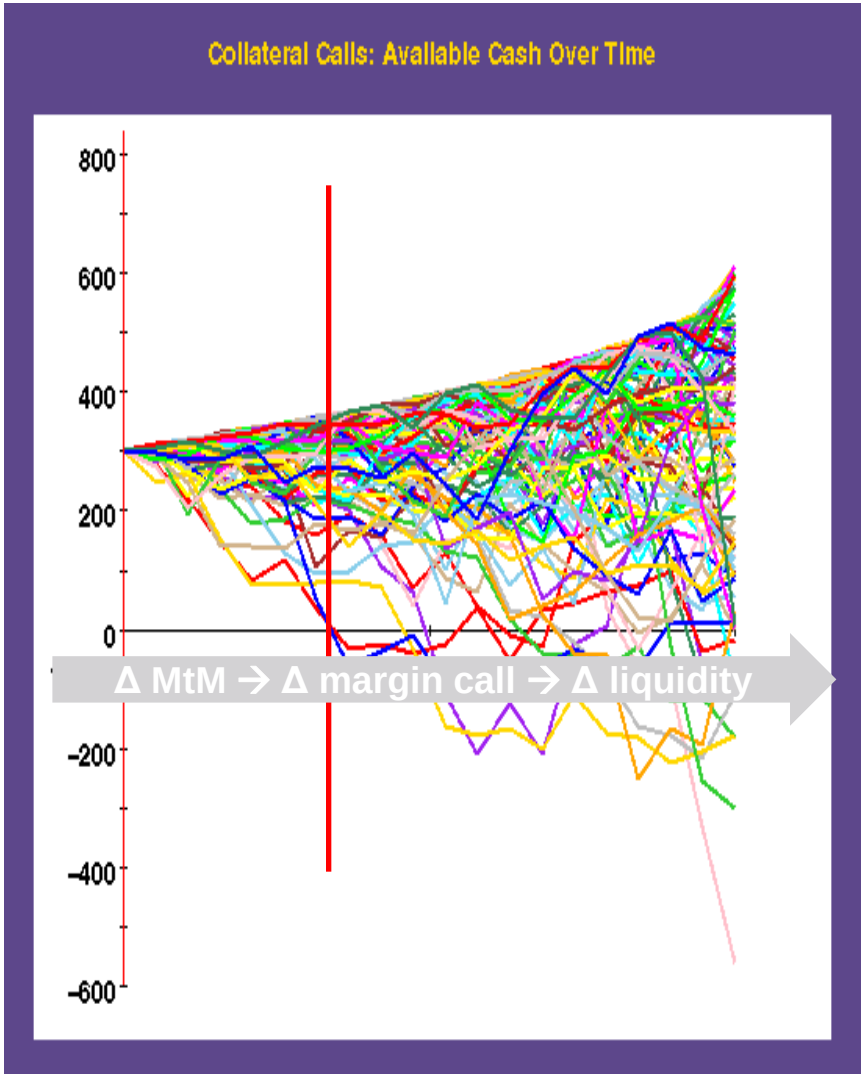
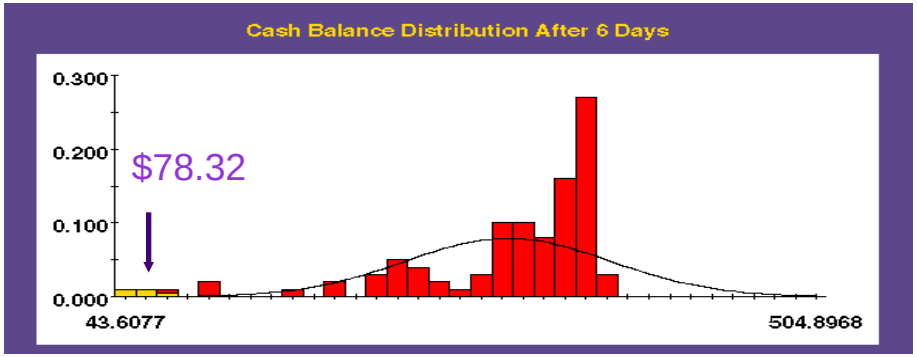
Stress-testing Funding Liquidity





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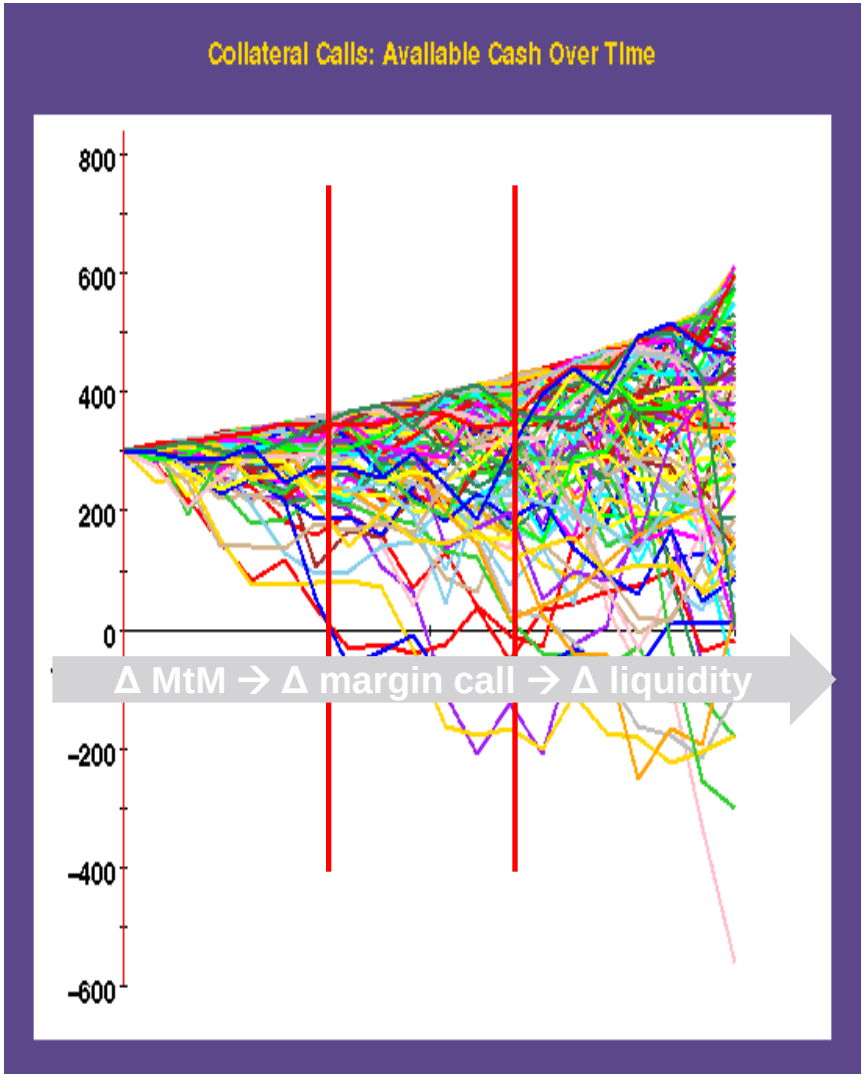

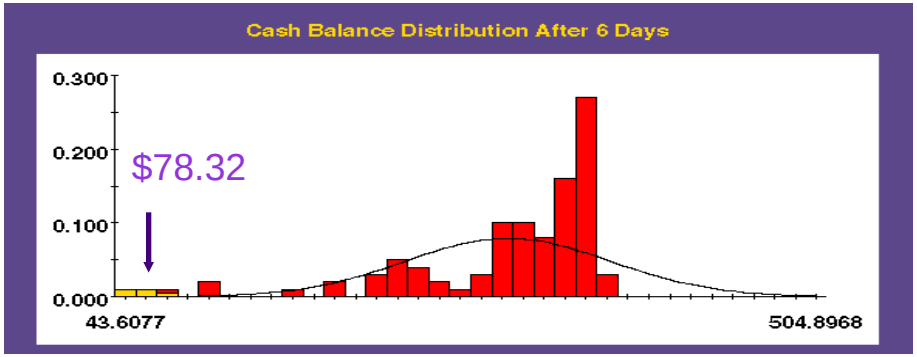

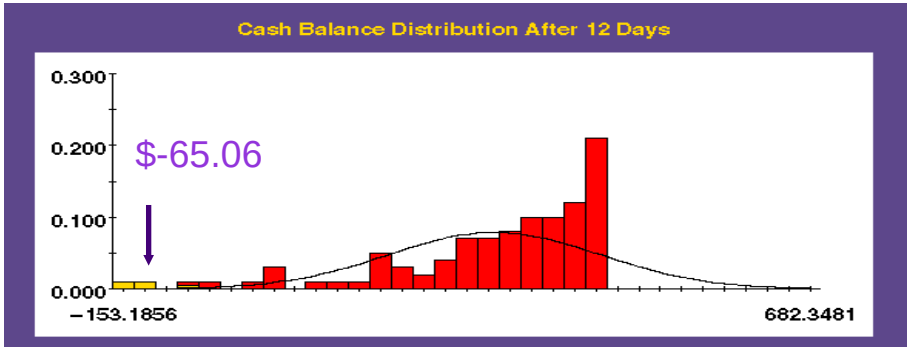

Algorithmics

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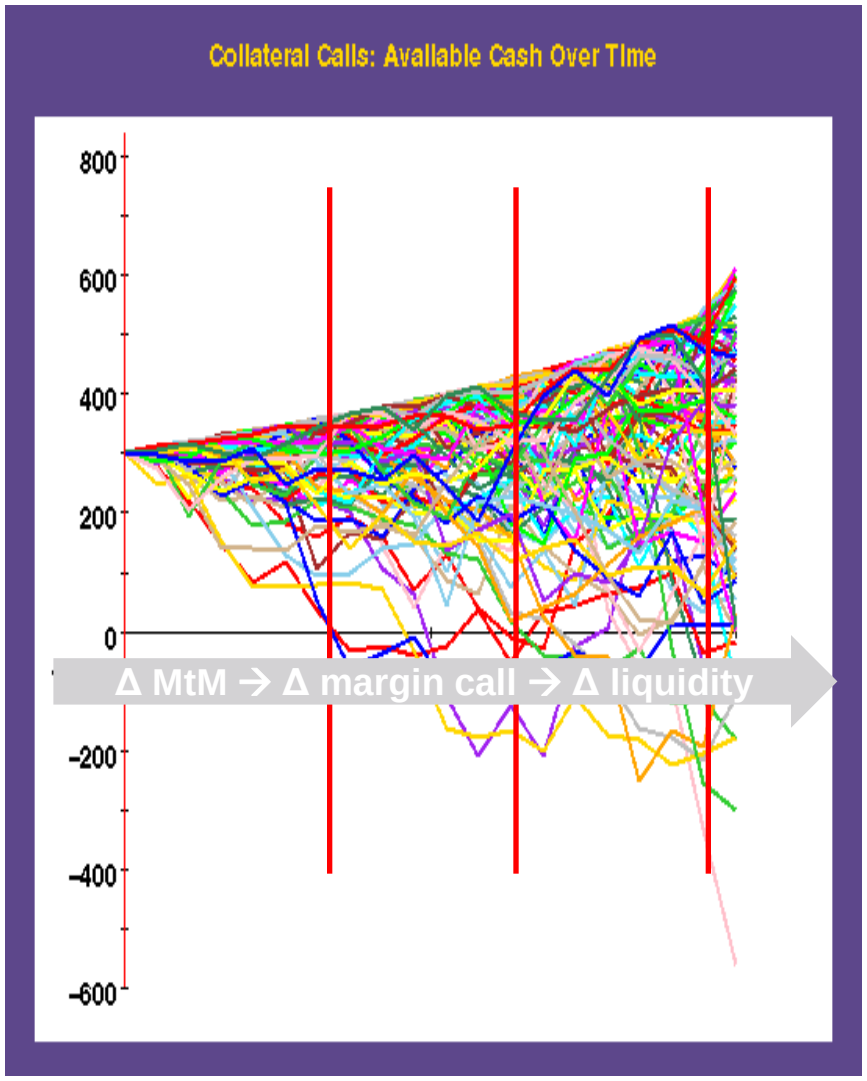

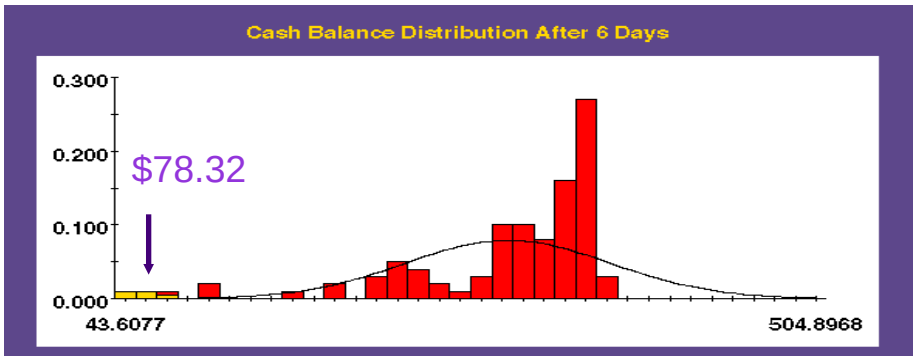

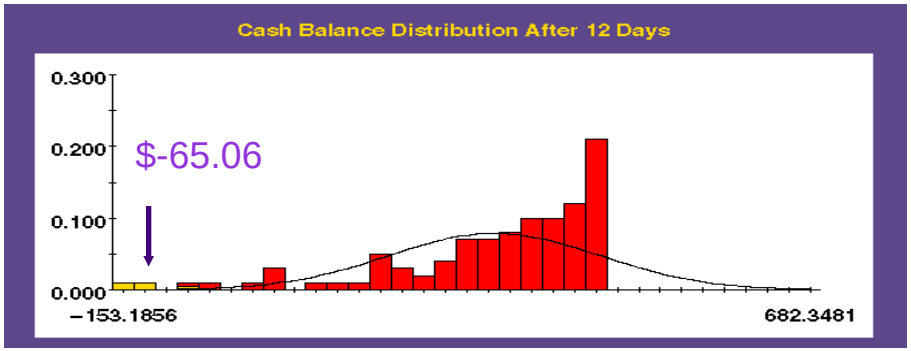

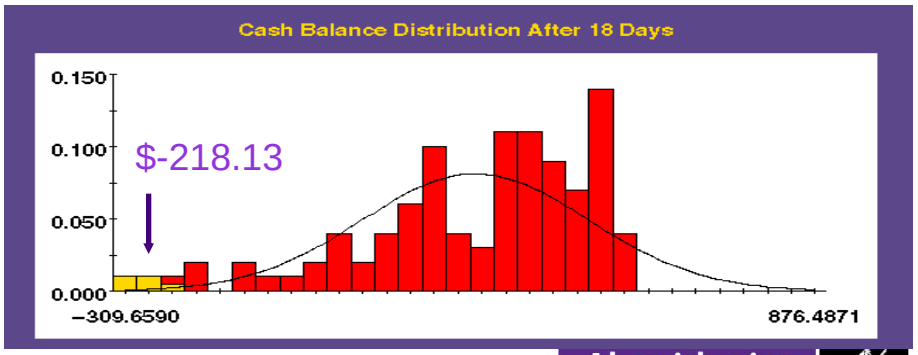

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Five Challenges: Enterprise Risk

Fundamental Themes

- Define the stakeholders
- Explain. Don't describe
- Imagine. Question assumptions
- Pursue full integration
- Enable meaningful actions

Bus Driver Scalps Bus Thanks To GPS Guidance

Algorithmics

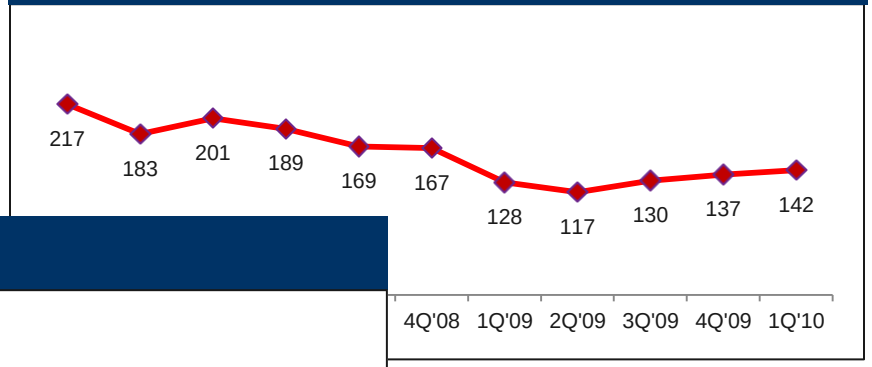
1. Define the Stakeholders

Shareholders ≠ Depositors ≠ Regulators ≠ Treasury

Tier 1 Capital Ratio

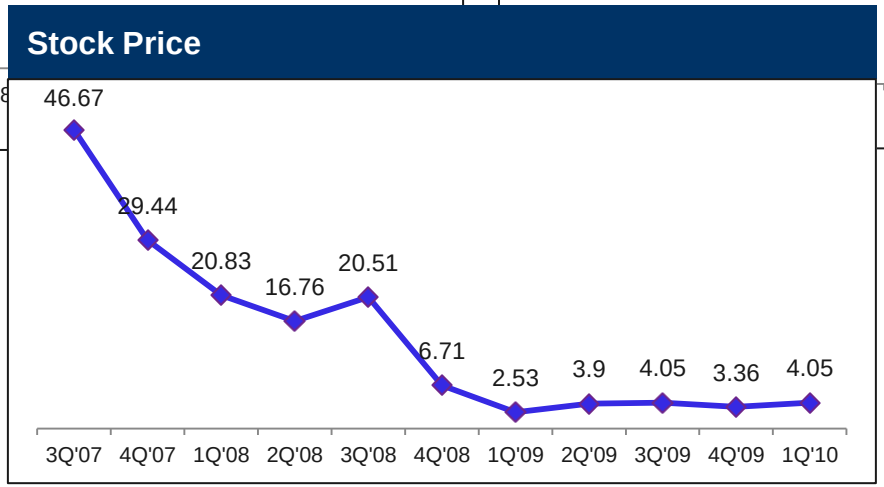
Source: Regulatory Disclosures

Trading Account Liabilities



Source: Public Filings

Stock Price



Source: Public Data Sources

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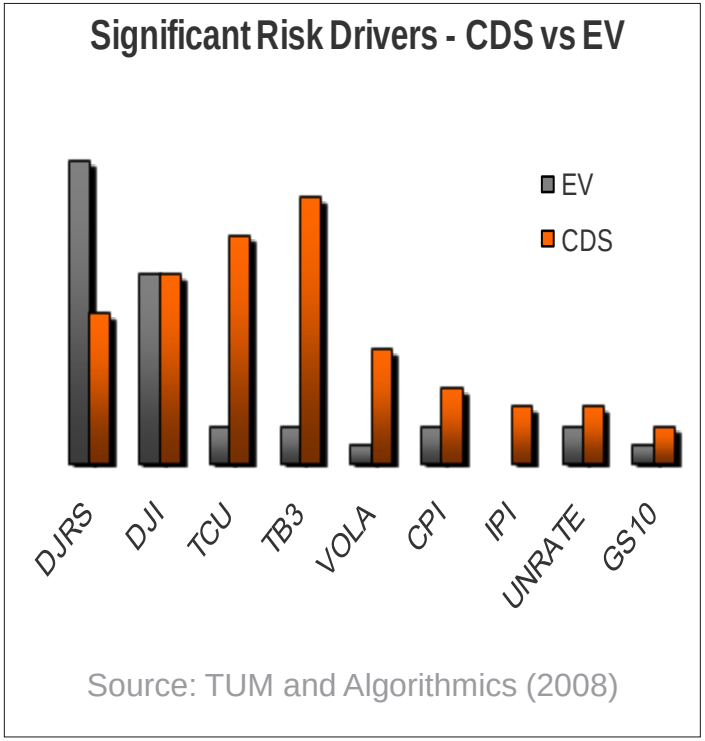
2. Explain. Don't Describe

Identify risk drivers

- Acknowledge that the use of data involves subjective judgment
- Build on an intuitive 'story line' rooted in a clear economic interpretation
- Explore what could happen, don't describe what the market implies will happen



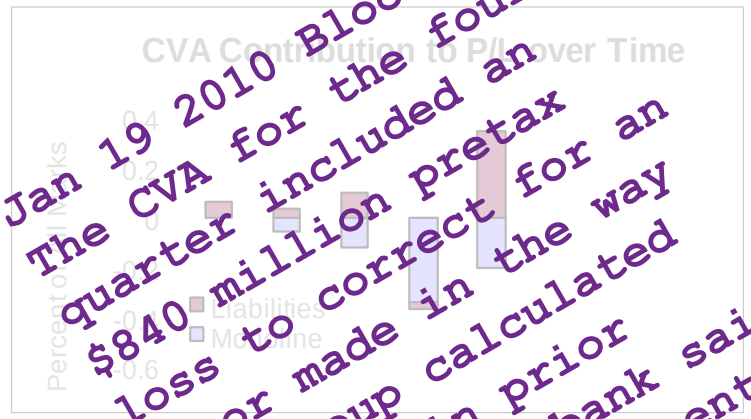
Source: TUM and Algorithmics (2008)

Algorithmics

2. Explain. Find the Link between Model and Reality

Example: Credit Value Adjustment

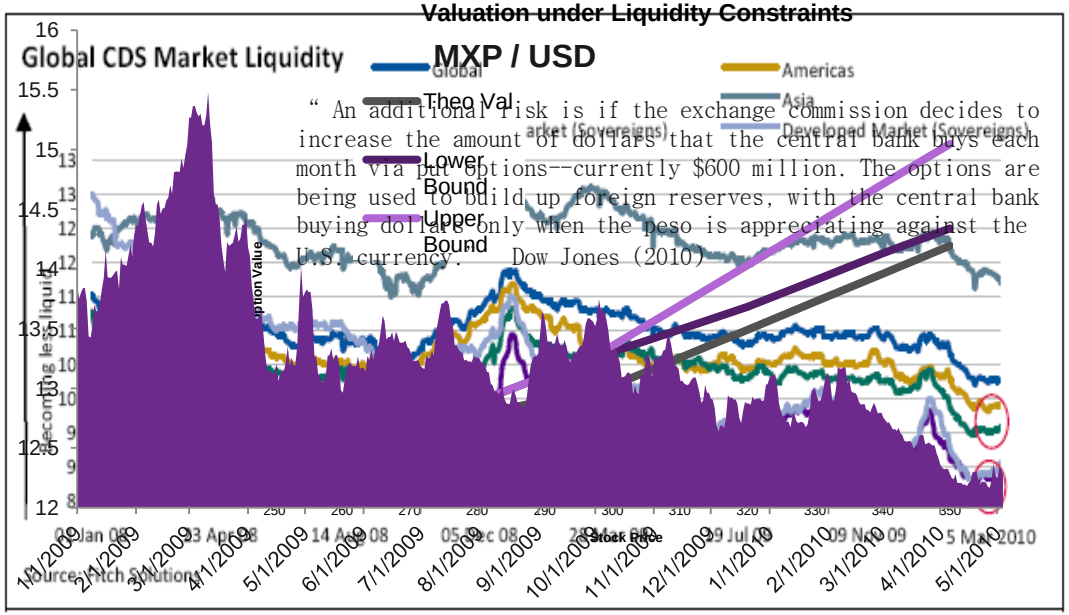
- Why is the credit spread ‘risk neutral’?
- How would we hedge CVA changes?
- How would we capture wrong way risk?
- How would we hedge our own default risk?
- How would we aggregate across products?



3. Imagine. Develop Unorthodox Scenarios

Challenge common wisdom

- How ‘risk-free’ is risk-free?
- Are consistencies really ‘consistent’?
- How to value FX options issued by the central bank?



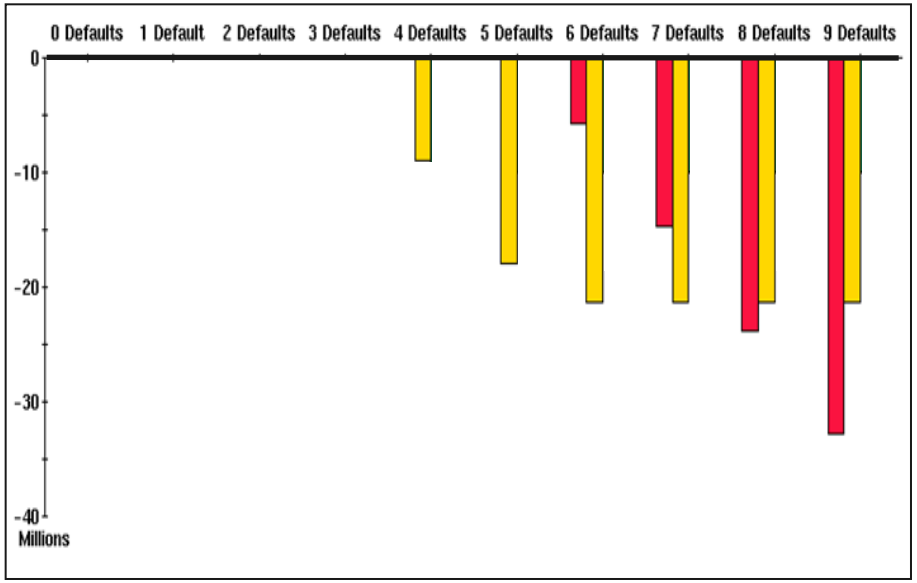
Source: Algorithmics (2010)

3. Imagine. Question Assumptions

Would you consider this position risk free?

Because they were treated as fully hedged, the positions were netted to zero and did not utilize VaR and Stress limits.

UBS (2008)



CDO – Shortfall by Tranche

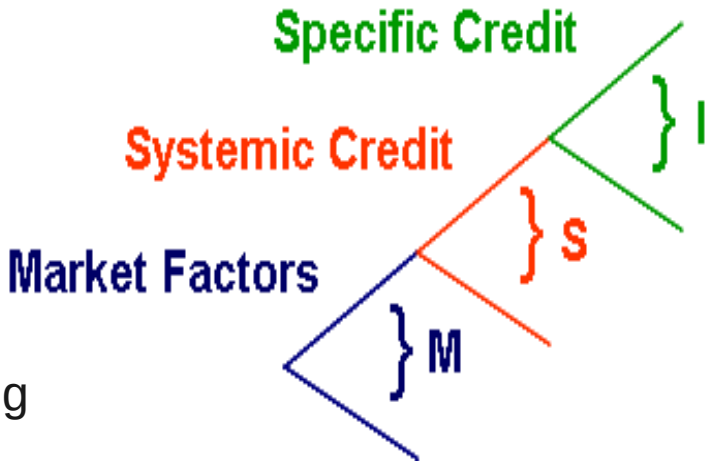
Source: Algorithmics

Algorithmics

4. Pursue Full Integration

Next-generation ERM must break down silos

- Firm-wide
- Across all asset and liability classes
- Covering all relevant risks
- Consistent and comparable
- Intuitive: Roughly right, not precisely wrong



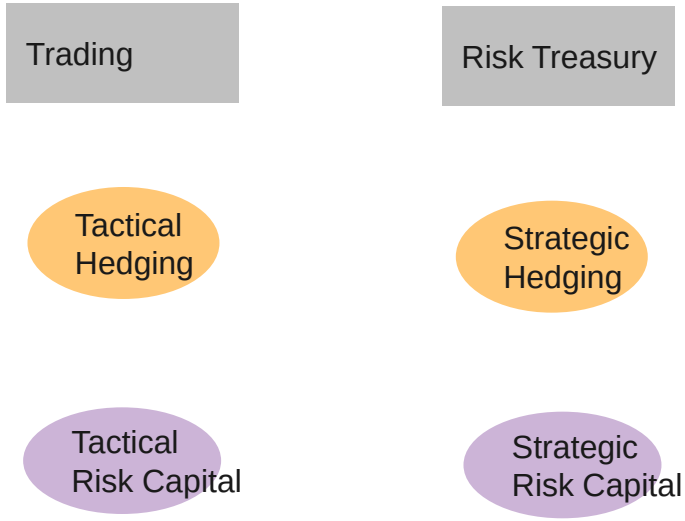
Algorithmics Three-Tier Simulation

Algorithmics

5. Enable Meaningful Actions

Risk management matters only if it results in actions

- Create an **empowered** ERM function
- Establish a central risk treasury with transfer-pricing of risks
- Operationally integrate risk and business functions
- Implement strong risk governance with well defined accountabilities



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Five Challenges: Systemic Risk

A central simulation platform would enable supervisors to …

- Develop approaches that are specific to systemic risk
- Imagine and explain: Turn unorthodox story lines into confidential scenarios
- Challenge: Set and modify assumptions
- Integrate: Ensure scenario and modeling consistency
- Enable: Assess impact of actions interactively

‘Platform’ = Sustainable, scalable, flexible, timely, actionable

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Implementation Challenges and Solutions

Granular data = extensive data requirements

- Most relevant firms have the required data and use it (Basel 2, IMM)
- Initiatives exist to establish standard instrument and counterparty definitions
- Compression techniques are used today, e.g. **replication** in insurance

Feasible and efficient simulation models

- **Today's technology** makes system wide simulation feasible
- Efficiency gains with **'conditional' scenarios** and replication

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Feasibility: Today's Technology

Processing requirements consistent with industry practice

- Leading firms have 50,000 – 80,000 CPU grids today
- High level calculations suggest that this would be a very generous upper bound for full systemic risk simulations
- Rapid technological advances (eg GPUs)

Key decision: Oversight by narratives vs 'hard' measures!

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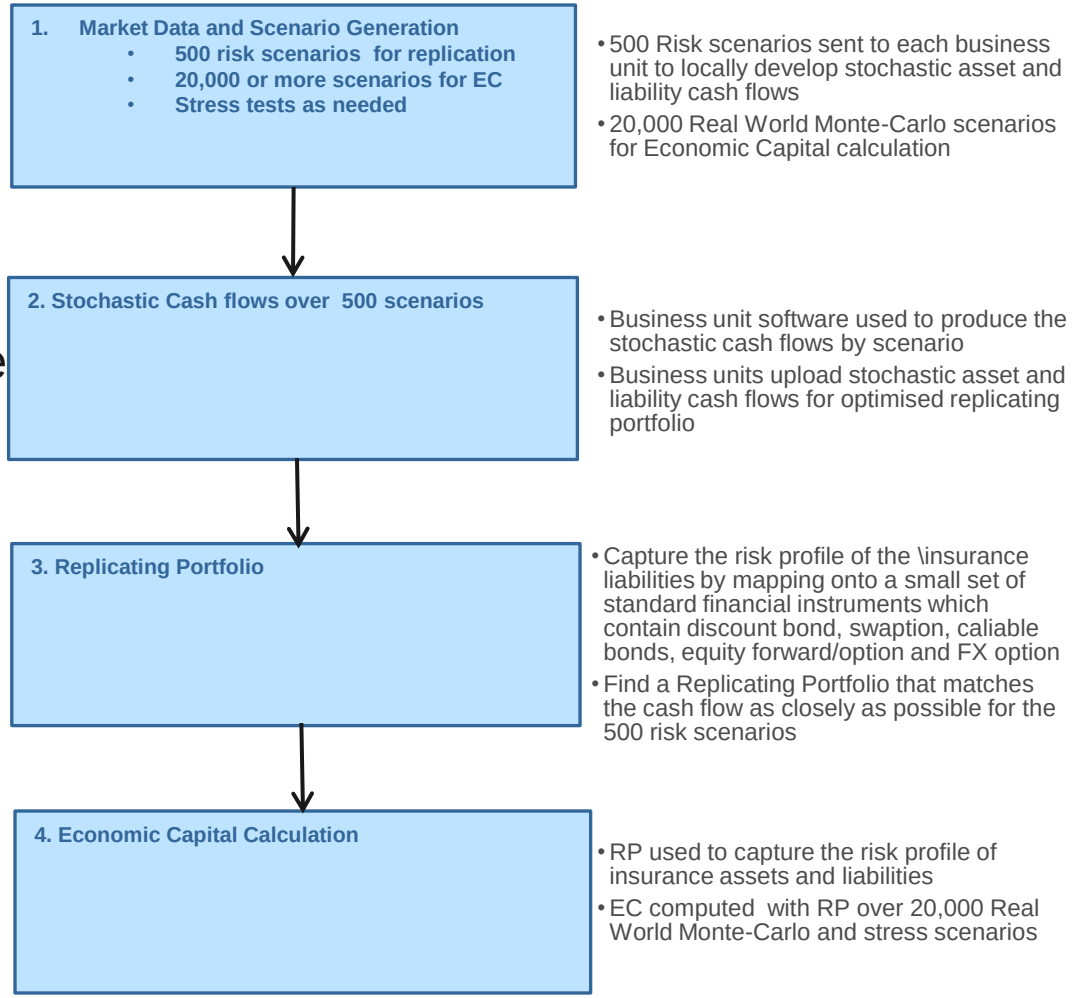
Feasibility: Replication

Reducing complexity and size

- Use optimization tools to create compact replicating portfolio (RP) over representative scenario set
- RP has similar risk profile as large and complex original book
- Use RP to compute economic capital over full scenario set
- In production for statutory disclosures at global insurers
- Robust behavior during turmoil
- Potential for other uses: pricing, intuitive communications, hedging …



Adapted from: ING (2009), Annual Report

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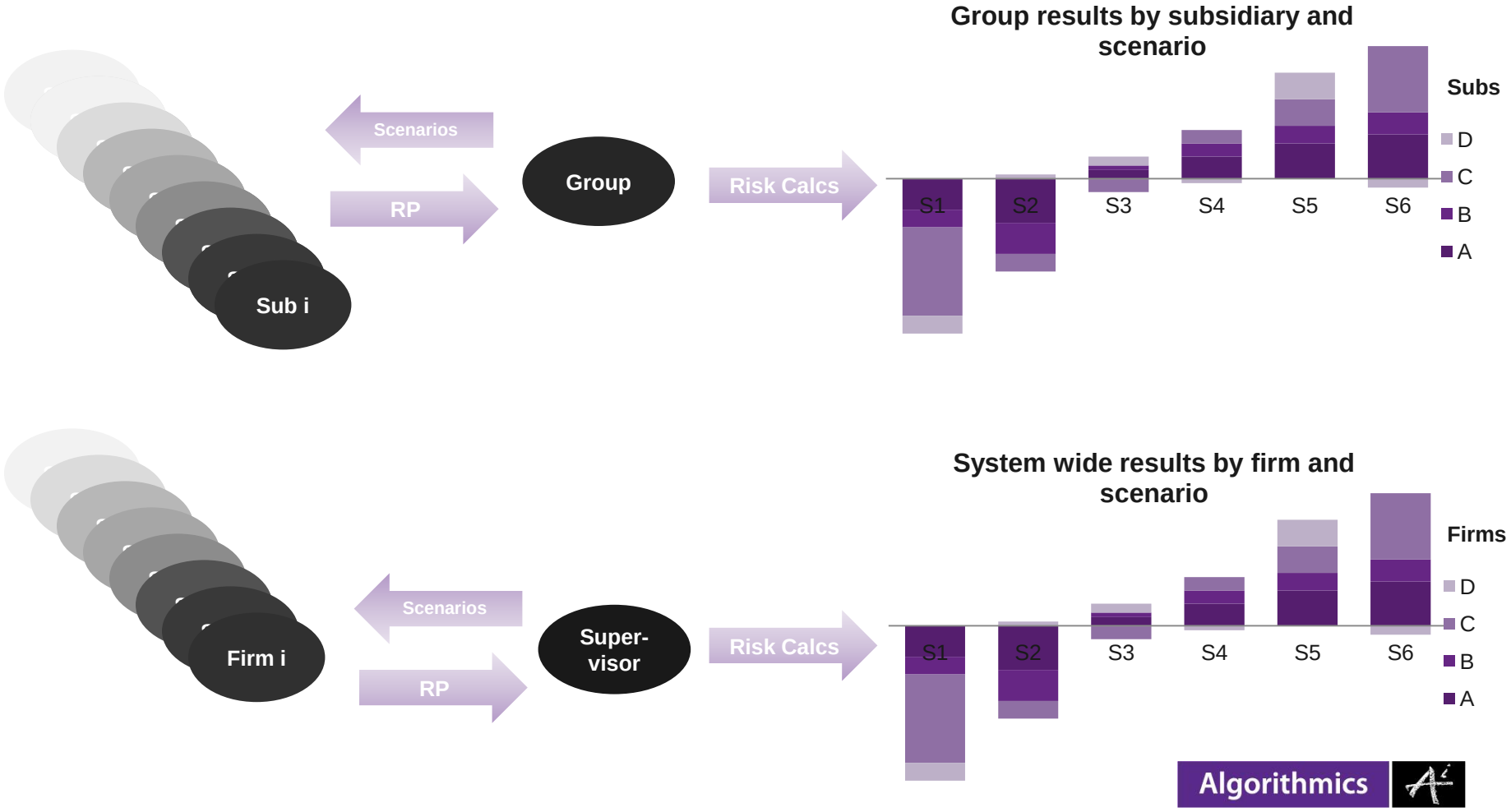
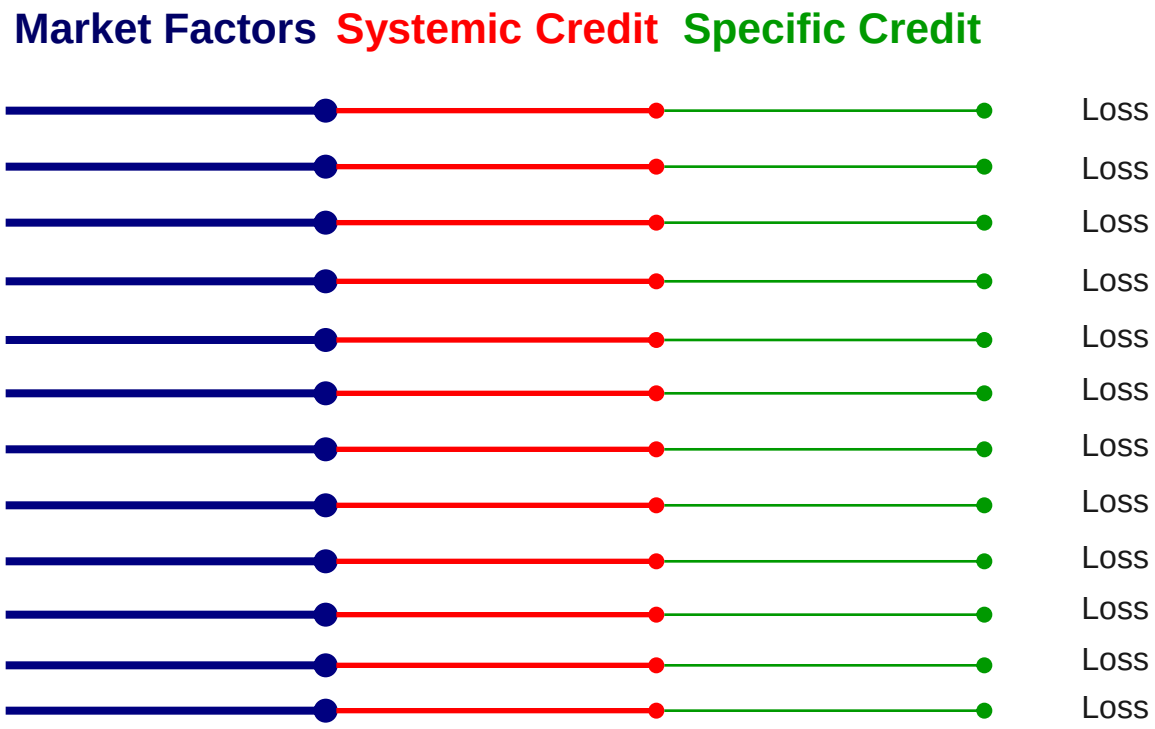
Feasibility: Replication

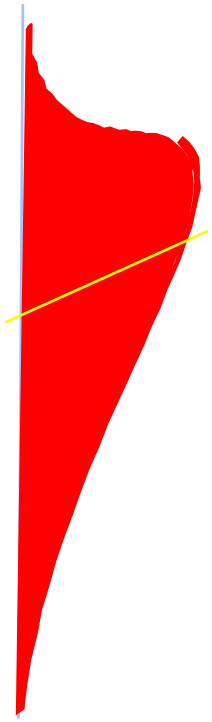
Applied to systemic risk



Feasibility: Conditional Scenarios

Brute Force: 'One tier' simulation





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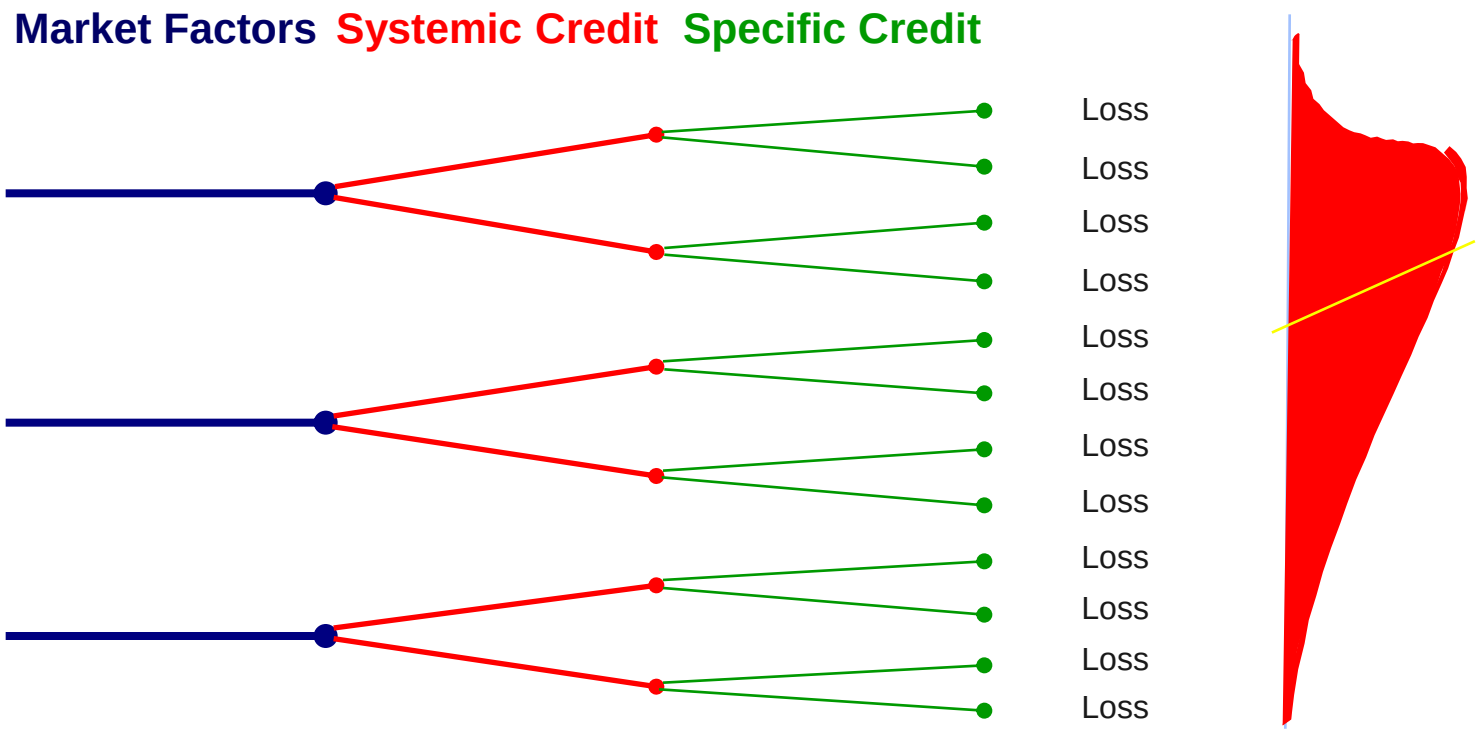
Feasibility: Conditional Scenarios

'Three tier' simulation

$$Var(\bar{\ell}) = \frac{\nu_1}{M} + \frac{\nu_2}{MS} + \frac{\nu_3}{MSI}$$



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ERM and Systemic RM: Potential Commonalities

Understanding the impact of ...

- Exogenous shocks: e.g. stress testing
- Interrelationships between risk strands: e.g. wrong-way risk
- Concentrations: e.g. industries, obligors or risk factors
- Future activities and behavioral responses
- Underlying assumptions and pragmatic implementation choices

To determine risk capital and funding liquidity buffers

To set incentives and drive risk-aware decisions

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Systemic RM: Unique Characteristics

Understanding the impact of …

- Assets (receivables) and liabilities (payables)
- Network structure and dependencies
- Endogenous effects, e.g. contagion
- Feedback loops
- Potential interventions

To determine (marginal) systemic risk capital

To enable effective macro-prudential actions and policy

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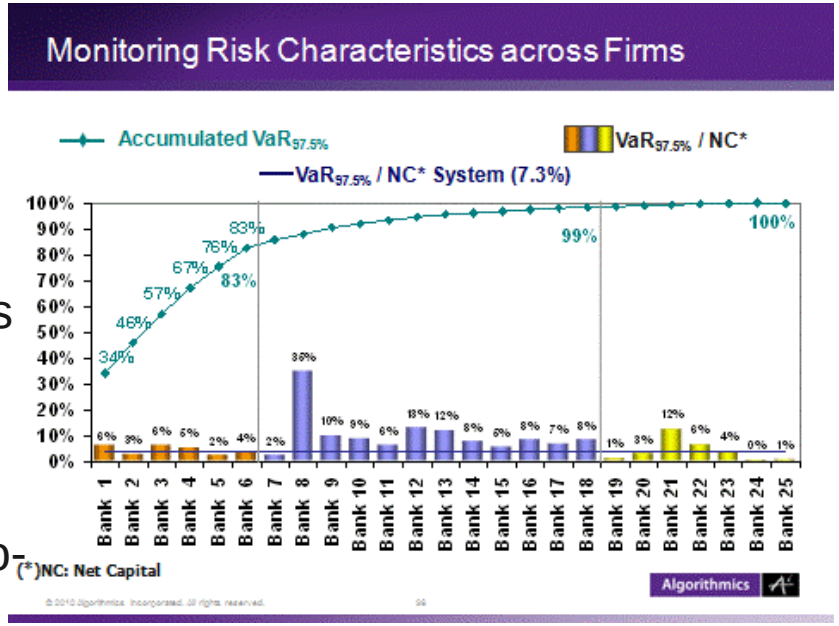
Adapting ERM applications: The Promise

Questions we may be able to answer better ...

- How vulnerable is each firm to specific ad-hoc stress tests (imaginative macro shocks or specific defaults)?
- Which firms spread or stop cascading defaults?
- What's the marginal systemic risk capital or cost of insurance by firm?
- What is the effect of specific assumptions (modeling or behavioral)?
- Which positions or business areas are of concern across firms or scenarios ?
- How can authorities mitigate the risks pro-actively? More capital, a liquidity facility, leverage or liquidity ratios, macro hedges?
- How can authorities target bailouts or other interventions effectively?



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A Call for Action I

Risk Management

Firms are constrained in their ability to effectively aggregate and monitor exposures across counterparties, businesses, risk strands and other dimensions.

Substantial work is still needed.

Senior Supervisors Group (2009)

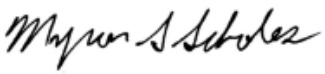
A Call for Action II

Systemic Risk

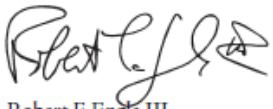
Legislation […] must include provisions to strengthen research efforts and provide the government with previously unavailable data and analytical capabilities.

Letter to Senator Dodd, Committee to Establish the National Institute of Finance, (February 2010)

Harry Markowitz
Adjunct Professor of Finance
University of California, San Diego
Nobel Prize in Economic Sciences, 1990

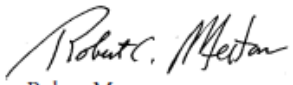


Myron Scholes
Frank E. Buck Professor of Finance, Emeritus
Graduate School of Business, Stanford University
Nobel Prize in Economic Sciences, 1997



Robert F. Engle III
Michael Armellino Professor of Finance
New York University Stern School of Business
Nobel Prize in Economic Sciences, 2003

William F. Sharpe
Professor of Finance, Emeritus
Stanford University
Nobel Prize in Economic Sciences, 1990



Robert Merton
Nobel Prize in Economic Sciences, 1997

Vernon Smith
Nobel Prize in Economic Sciences, 2002

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