FINANCIAL STABILITY INSTITUTE

BANK FOR INTERNATIONAL SETTLEMENTS

Regional Seminar on Global Financial Turmoil and the Changing Face of Financial Sector Supervision

Introduction in Stress Testing

Jointly organised by the
Financial Stability Institute (FSI) &
Financial Services Volunteer Corps (FSVC) &
MENA Financial Regulators' Initiative

Cairo, Egypt, 7-9 April 2009

Stefan Hohl, FSI/BIS, Senior Financial Sector Specialist

Agenda

- The current crisis
  - Risk Management Failures - What went wrong?
- Supervisors and stress testing
  - Basel II
  - Examples for some risk classes
  - BCBS principles
  - Main challenges

Some observations resulting from the crisis …

- Risk management and especially stress testing did not perform well, a few main shortcomings …
  - Assumed credit spread widening too small and short
  - Duration for stress test in general too short
  - Not enough specified for complex products
  - Many problems in liquditiy risk
    - Market access
    - Diversity of funding
  - Correlation between asset classes
  - Basis risk betwen cash bonds and credit default swaps
  - Management buy-in, …

Some observations resulting from the crisis …

- BCBS paper – Principles for Stress Testing (January 2009)
- BCBS paper highlights weaknesses in stress testing practices employed prior to the start of the turmoil in four broad areas:

1. Use of stress testing and integration in risk governance

  - Board and senior management involvement in setting stress testing objectives, defining scenarios, discussing the results of stress tests, assessing potential actions and decision making is critical
  - foster internal debate or challenge prior assumptions
  - many banks did not have an overarching stress testing program in place but ran separate stress tests for particular risks or portfolios with limited firm–level integration.
  - inability to aggregate exposures quickly, apply new scenarios or modify models. Need greater flexibility in IT infrastructure

Some observations resulting from the crisis …

2. Stress testing methodologies
   - weaknesses in infrastructure limited the ability of banks to identify and aggregate exposures across the bank
   - assumed that historical relationships constitute a good basis for forecasting the development of future risks.
   - reactions by market participants within the system can induce feedback effects and lead to system-wide interactions
   - management did not sufficiently question the limitations of more traditional risk management models used to derive stress testing outcomes nor did they sufficiently take account of qualitative expert judgment to develop ad-hoc stress scenarios.
   - stress tests were insufficient in identifying and aggregating risks

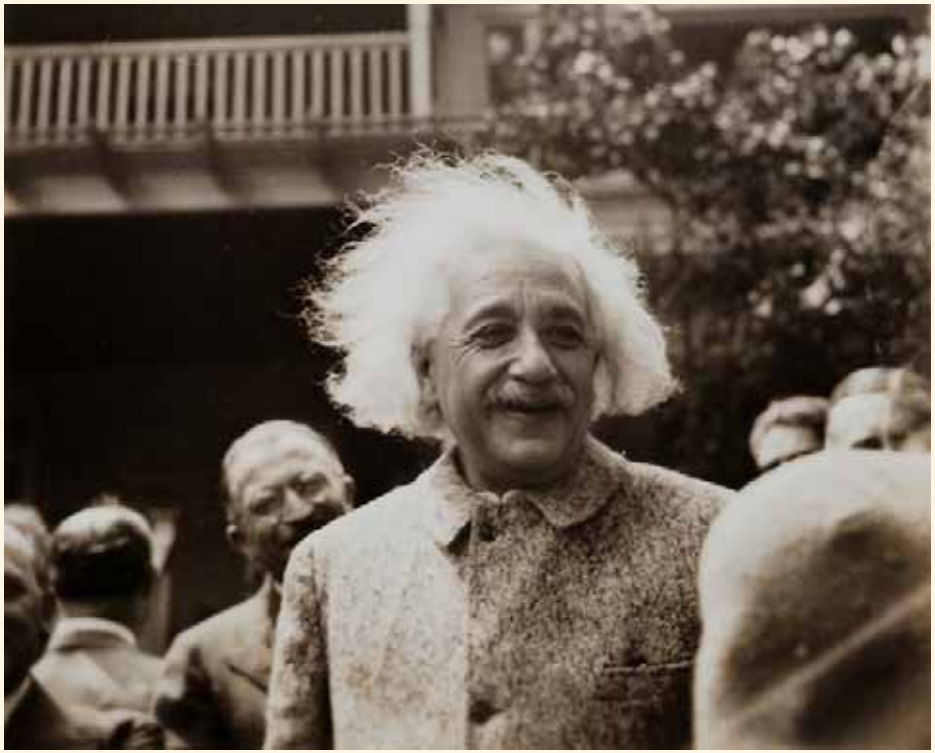
Some observations resulting from the crisis …

3. Scenario selection;
   - Scenarios tended to reflect mild shocks, assume shorter durations and underestimate the correlations between different positions, risk types and markets due to system-wide interactions and feedback effects.
     - "severe" stress scenarios typically resulted in estimates of losses that were no more than one quarter of earnings.
   - historically based stress tests underestimated the level of risk and interaction between risks.
   - Banks also implemented hypothetical stress tests,
   - Difficult for risk managers to obtain senior management buy-in for more severe scenarios. Too extreme or innovative scenarios were often regarded as implausible by senior management and the board.

Some observations resulting from the crisis …

4. Specific risks and products;
   - stress tests of structured products suffered from the same problems as other risk management models (excessive reliance on historical data or ratings)
   - Do not capture wrong-way risk, for example related to the credit protection from monoline insurers.
   - With regard to funding liquidity, stress tests did not capture the systemic nature of the crisis or the magnitude or duration of the disruption to inter-bank markets.
   - Had stress tests adequately captured contractual and reputational risk associated with off-balance sheet exposures, concentrations in such exposures may have been avoided.

Relative importance? ... Einstein knew it …



Logic will get you from A to B.

Imagination will take you everywhere.

Albert Einstein

Recall, what are good stress tests?

- Plausibility
  - Importance of a plausible but severe scenario
  - Typically probability is not attached, however, there is a desire to have a probability for its occuring
  - Should be believable and spur discussion
- Consistency
  - Realistically, joint movement of risk factors
  - Similar application across scope (within, across banks)
- Reporting
  - Understandable for management
  - Allow for adequate reactions, responses
  - As such, should be relevant to current positions

… for bank‘s objectives

- Risk management tool to evaluate impact of adverse effects on capital and liquidity
- Complementing statistical models (VaR, etc) and data
- Identification of bank‘s vulnerabilities given their portfolios
- Support internal and external communication
- Feed into capital and liquidity planning
- Inform the setting of bank‘s risk tolerance
- Facilitate risk mitigation or contingency plans across a range of stressed conditions
- Proper asessment of impact on
  - Non-peforming loans as well as
  - Earnings, Capital and Liquidity

Supervisors and stress testing

- Enhanced role for stress testing
  - Core Principles
  - Financial Stability Forum‘s recommendations
- Specific risk management tool to identify
  - Risk profile, risk measurement, risk control instrument
- Complementary tool to statistical risk models (Pillar 1)
  - IRB, AMA, market risk VaR, economic capital models
- Forward–looking risk assessment tool
  - Dealing with cyclicality of capital requirements
  - Identification of liquidity needs
  - Principle 1 of Pillar 2 (ICAAP)

Basel II – Stress testing (1)

- Stress testing requirements in Pillar 1
  - To supplement the shortcomings in its tools
  - To be applied for the more advanced approaches
  - To deal with procyclicality, i.e. capital in banks is higher than minimum regulatory capital

- Broadly speaking, in Pillar 1, stress testing requirements seek to deal with
  - parameter uncertainty, and
  - IRB cyclicality issue

Basel II – Stress testing (2)

- Specific requirements in Pillar 1
  - CRM – own estimates for haircuts
    - Deal with illiquidity of lower-quality assets
  - IRB – rating assignment horizon
    - Rating may be based on specific, appropriate stress scenarios

Basel II – Stress testing (3)

- IRB - stress tests used in assessment of capital adequacy
  - More general tests with impact on capital, plus
  - Credit risk stress test to assess the effect of specific conditions on its IRB capital
    (for example mild recession scenarios)
  - Three specific data requirements
    - bank‘s own data for migration analysis
    - impact of smaller deterioration in the credit environment
    - ratings migration in external ratings

Basel II – Stress testing (4)

- Specific requirements in Pillar 1
  - IRB – internal model approach for equity exposures
    - Deal with tail events for private and public equities
  - IRB – rating assignment horizon
    - Rating may be based on specific, appropriate stress scenarios
  - Securitisation - internal assessment approach for ABCP
    - Stress factors used for determining credit enhancement requirements
  - OpRisk – AMA quantitative standards
    - Correlation estimates in times of stress

Basel II – Stress testing (5)

- Specific requirements in Pillar 2
  - Principle 1 – banks own capital assessment (ICAAP)
    - Unclear whether forward-looking stress testing to be applied to all material risks
    - Specifically for market risk
    - Required as a part of internal control review
  - Principle 2 – supervisory review of ICAAP
    - Supervisors required to review bank‘s testing exercises

Basel II – Stress testing (6)

- Specific issues in Pillar 2
  - Credit risk – stress testing under IRB
    - Results of Pillar 1 stress tests should support Pillar 2 expectation, i.e. banks operating above minimum capital requirements
    - To deal with credit risk concentrations periodically
  - Securitisation – Early amortisation
    - Forward-looking stress testing required generally

Basel II – Stress testing (7)

- Specific requirements in Pillar 3
  - Market risk - internal models approach (IMA)
    - For each portfolio covered by the IMA a qualitative description of stress testing is to be diclosed
- Example – credit concentration risk
  - Scenarios should reflect risk concentrations
  - Focus narrowly on joint risk factor moves
  - Not easy to set up scenarios where PDs, LGDs, EADs and correlations move together
  - Should take into account correlations between sectors
  - Only to be disclosed for CRM risk concentration

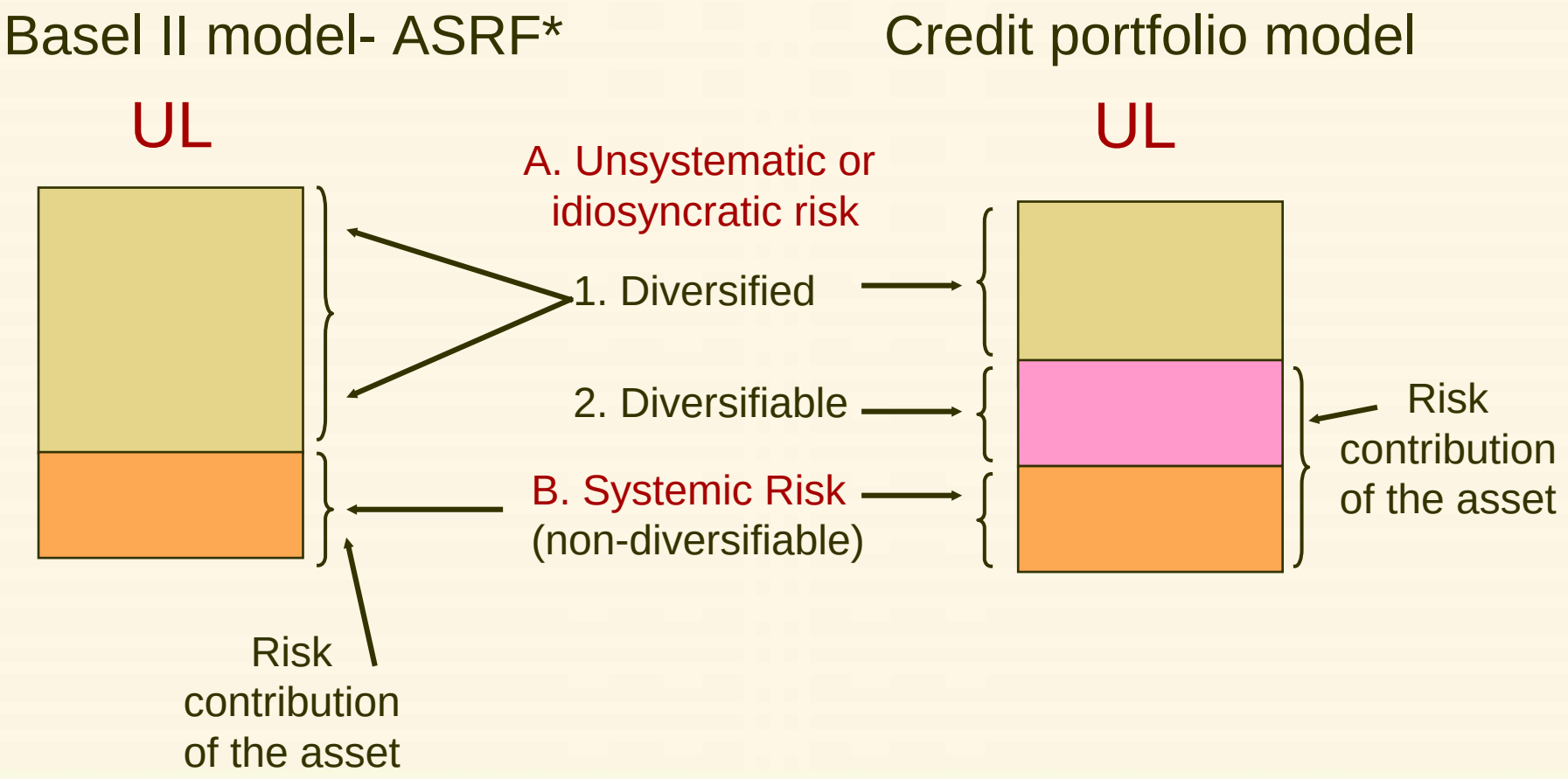
Example - market risk

- As part of the Market Risk Amendment requiring
  - Inclusion of low probability events
  - Inclusion of both linear and non-linear products
  - Incorporate quantitative and qualitative aspects for both market and liquidity risk
- Asking banks in at least three areas
  - Bank‘s simulating own scenarios
  - Standardised scenarios
  - Historical loss information

Example - liquidity risk

- Stress test for both, funding liquidity and market liquidity risk
  - Focus on selling assets and availability of markets for liquid funds
  - Including at a minimum modelling future cash flows and (depositor) behaviour assessment
- Importance of a well-functioning interbank market
  - Shocks (i.e. bank failure) could trigger contagion by withdrawing liquidity by banks
  - High reserve or liquid asset requirements could discourage such an interbank market
- In Basel II no explicit requirement for stress testing

Diversification and concentration risk



Asymptotic single risk factor (ASRF)

Stress testing of concentration risk -1

- Stress tests for ConRisk have to be set apart from existing pillar 1 or pillar 2 stress tests
- Stress testing for ConR, no concern of parameter uncertainty, as stress tests in pillar 1
- Also no use of a stress scenario for the whole macroeconomy, as required in pillar 2 (para. 434)
- Rather, focus narrowly on identified or suspected credit risk concentrations, according to para. 775
- Interested in the EL of the portfolio in scenarios where risk concentrations are subject to stress

Stress testing of concentration risk -2

- Some issues with traditional stress tests for credit risk
  - How to estimate plausible stressed values for PDs or correlations?
  - Difficult to produce a scenario where PDs and correlations move together in a realistic way
  - How to stress correlation matrix and maintain positive semi-definiteness?
  - Very difficult to explain and report if many parameters are stressed at the same time

Stress testing of concentration risk -3

- Advantages of using multi-factor models
  - Plausible because based on economic scenario
  - Internally consistent because generated using credit risk model using a well-defined factor structure
  - Reportable because individual factors are stressed
  - Offers a way to incorporate new information into the model, while keeping model-implied, structural relationships between credits intact
  - Unstressed factors automatically behave consistently with stressed factors
  - Correlations between sectors are important and automatically accounted for through the factor correlations when stressing these factors

BCBS – principles for stress testing (Jan 2009)

- Recommendations to banks
  - Use of stress testing and integration in risk governance (6 principles)
  - Stress testing methodology and scenario selection (4 principles)
  - Specific areas of focus (5 principles)
- Recommendations to supervisors (6 principles)

Use of stress testing and governance -1

- Should be integral part of the overall governance and risk management culture of the bank; and should be actionable
- Should promote risk identification and control; provide a complementary risk perspective to other risk management tools; improve capital and liquidity management; enhance internal and external communication
- Should take account of views from across the organisation and should cover a range of perspectives and techniques

Use of stress testing and governance -2

- Documentation and written policies critical
- Should have a suitably robust infrastructure in place, sufficiently flexible to accommodate different and changing stress tests at different levels of granularity
- Should regularly maintain and update its stress testing framework; reviewed regularly and independently

Stress testing methodology, scenario selection

- Should cover a range of risks and business areas, including at the firm-wide level
- Should cover a range of scenarios, including forward-looking scenarios, and aim to take into account system-wide interactions and feedback effects
- Should generate most damage whether through size of loss or through loss of reputation; inclusion of scenarios challenging the viability of the bank (reverse stress tests to uncover hidden risks)
- Should aim to take account of simultaneous pressures in funding and asset markets, and the impact of a reduction in market liquidity on exposure valuation

Specific areas of focus

- Risk mitigation techniques should be challenged
- Complex and bespoke products such as securitised exposures; including underlying assets and their exposure to systematic risk, contractual arrangements and embedded triggers, impact of leverage particularly as it relates to the subordination level
- Pipeline and warehousing risks
- Reputational risk; integration of risks arising from off-balance sheet vehicles and other related entities
- Highly leveraged counterparties, also in assessing potential wrong-way risk (pseudo-hedging) related to risk mitigating techniques

Recommendations to supervisors -1

- Should make regular and comprehensive assessments of banks' stress testing programmes
- Should require management to take corrective action if necessary, including in the decision making process
- Should challenge the scope and severity of firm-wide scenarios; possibly asking banks to use specific scenarios or to evaluate scenarios under which their viability is threatened (reverse stress testing)
- Should use Pillar 2 to review bank's internal capital assessment and its liquidity risk management; including forward-looking stress testing for capital and liquidity

Recommendations to supervisors -2

- Should consider implementing stress test exercises based on common scenarios
- Should engage in a constructive dialogue with other public authorities and the industry to identify systemic vulnerabilities; Supervisors should also ensure that they have the capacity and the skills to assess banks' stress testing programmes

Stress test challenge – the macro-micro link

- Link between macro.economic scenarios and micro-level risk factors
- Modelling with a direct link
  - Macro-economic factors impacting PDs and LGDs
  - Probably important for day-to-day business
- Modelling with an indirect link
  - Macro-economic factors impacting asset values first, and then derived from that, PDs and LGDs
  - Can be modelled via an econometric model or by expert judgement
  - Mapping of macro factors to asset values is a key challenge for many scenarios, for example oil price shock or interest rate shock

Stress test challenge - severity level, time horizon

- Moderate vs more severe levels (once in 10, or 50 years)
  - No data, rather expert judgement
  - Tendency to moderate scenarios, because of limited data, structural breaks and applying „realistic“ scenarios
  - Should a systemic crisis be included? (Moral hazard)
- Time horizon usually related to liquidity of the portfolio
  - The more liquid the shorter the horizon
  - Management actions usually not included like portfolio rebalancing
  - Feed-back effects important consideration as stress situations usually do not materialise overnight

Final remarks

- Increased attention on stress testing in banks and by supervisors
- Stress testing is
  - no mystery to understand, though difficlut to implement
  - an important risk management tool
- Scenario selection is critical
  - Data availability is a binding constraint
- Some key challenges
  - Modeling the macro-micro link
  - Severity level and management buy-in
- One of the key tools for supervisors going forward