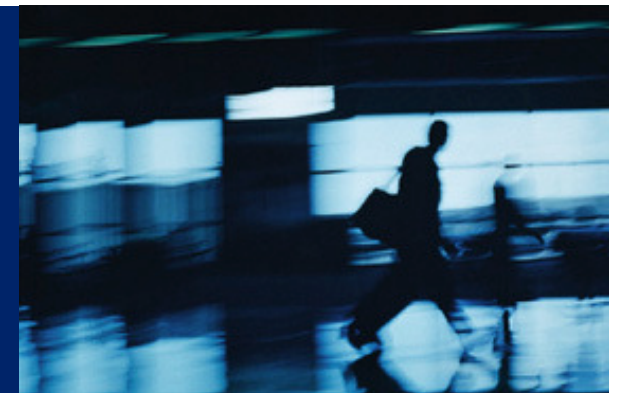


# Stress Testing in an Economic Capital context

Risk Breakfast – Technical Series  
London, 28 October 2005

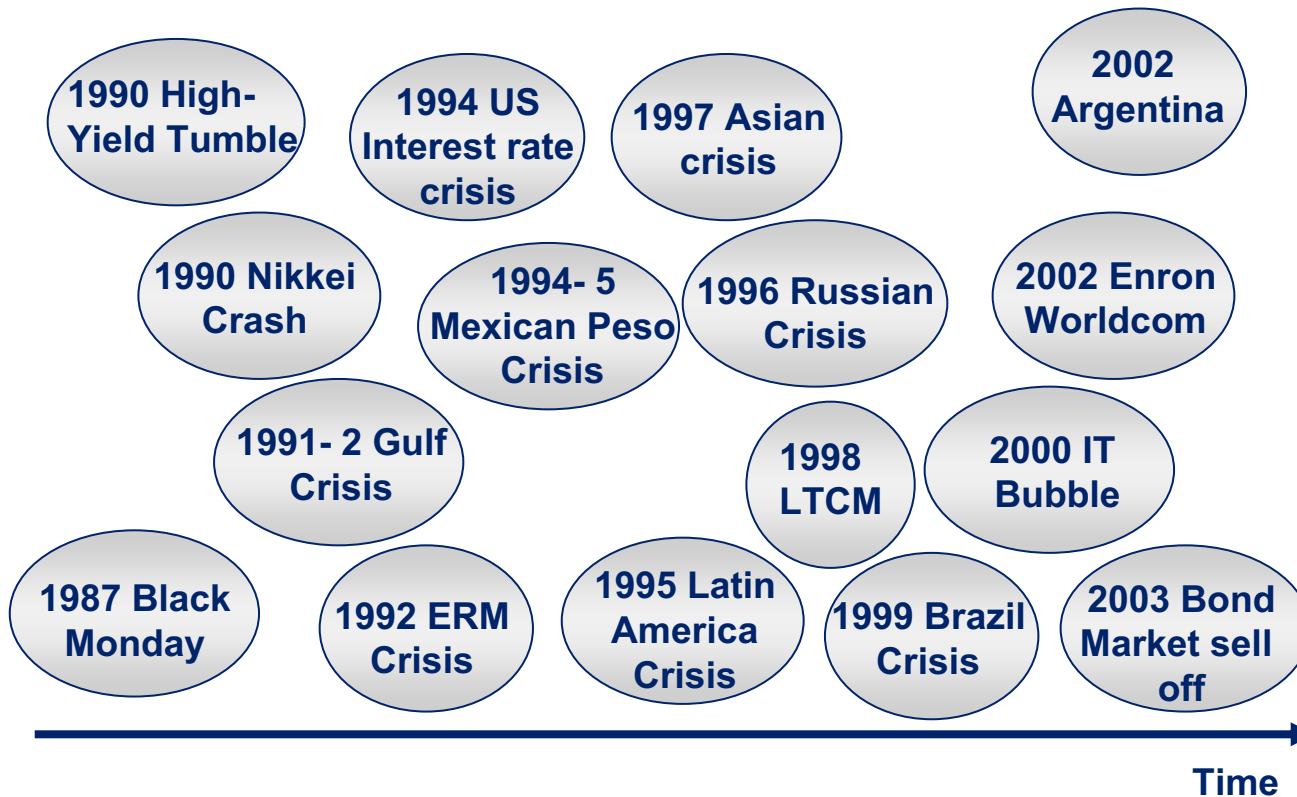
Dr Georg Stapper



## Agenda

- Introduction
- Purpose of Stress Testing
- Types of Stress Testing
- Risk Classification
- Risk Measurement
- Common Practice of Stress Testing
- Systematic Approach
- Examples
- Basel II requirements
- Appendix

# Recent Financial Markets Crises



## Features

- PD increase
- Correlation breakdown
- Illiquidity
- Hedging techniques fail
- Speed in spread of shocks

Source: MAS information paper 01-2003,  
BIS, Stress Testing at major financial institutions: survey results and practice, 2005

## Purpose of Stress Testing

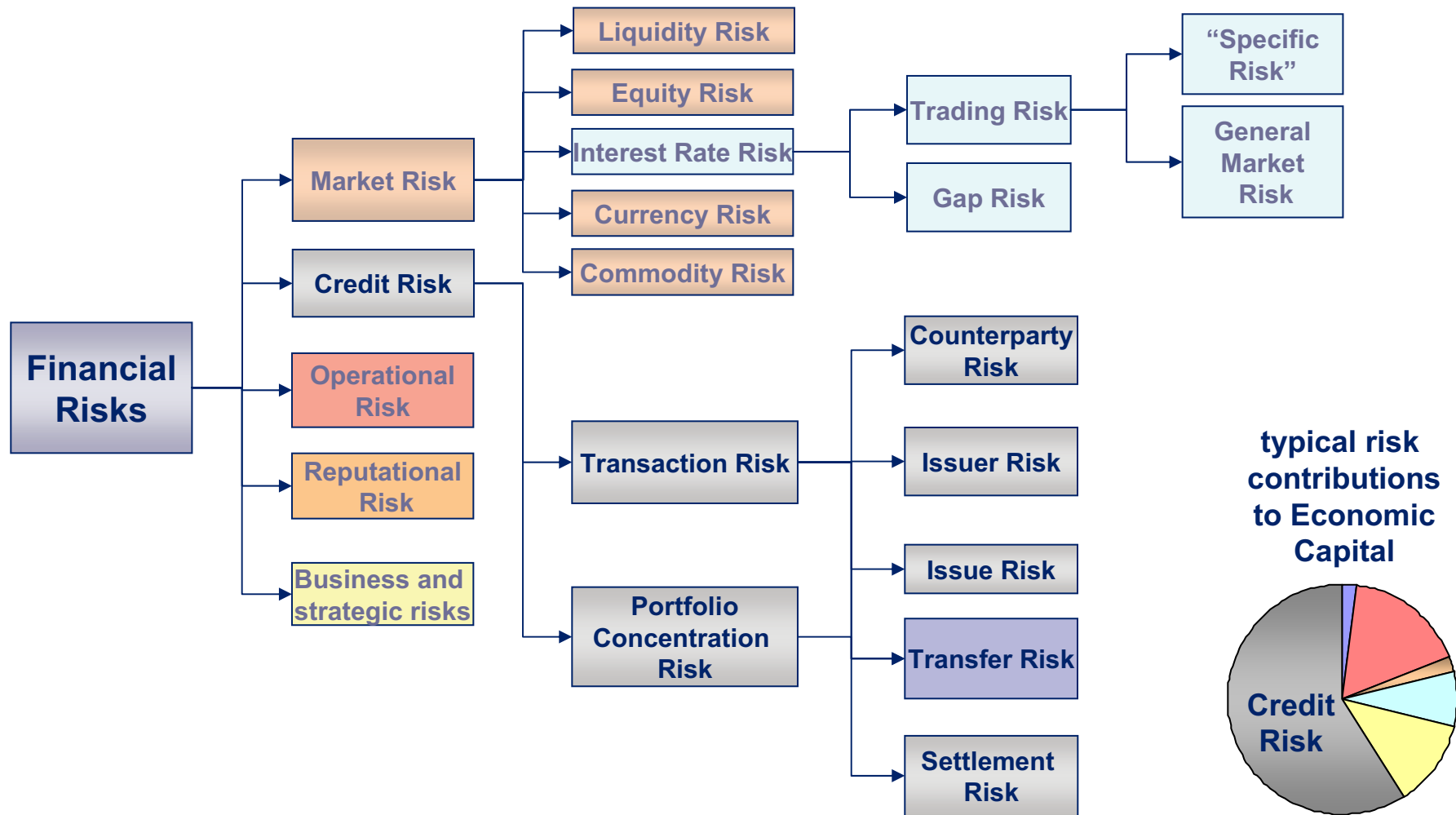
- ❑ Capturing the impact of a portfolio of exceptional but plausible large loss events
  - Prove that the impact of a recession is less than the computed capital level.
  - Known recessions should be within the bounds of the confidence level (conceptual target).
- ❑ Evaluation of business risks
- ❑ Understanding the risk profile of a bank
- ❑ Understanding the limitations of the models
- ❑ Limit/capital allocation or verification

## Stress Testing Types

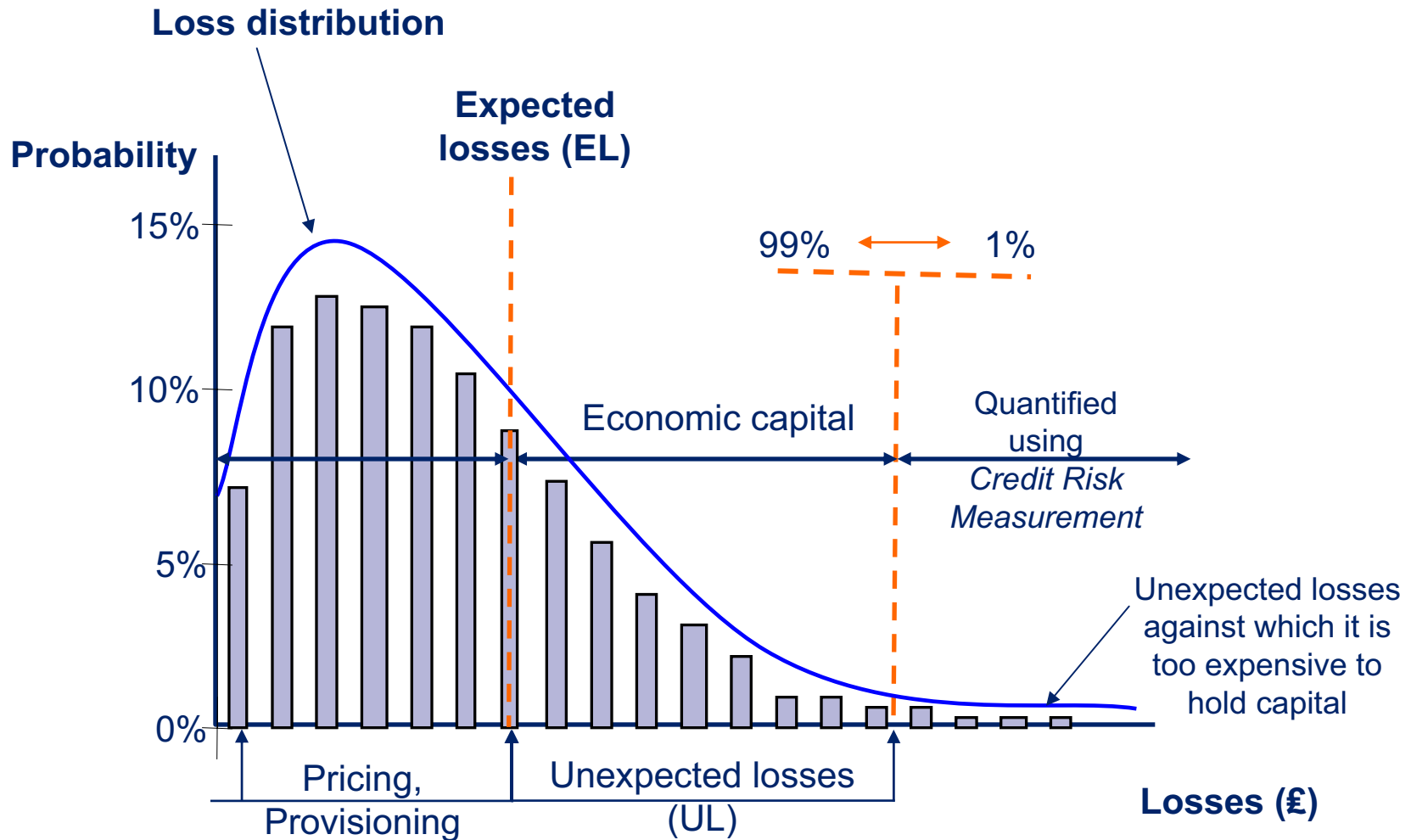
- ❑ Model parameters – structural stresses
- ❑ External events – macroeconomic impacts
- ❑ Internal events – systems failures, policy changes, etc.
- ❑ Business strategy – marketing plans, collections policies

Causality is essential (exceptional but plausible events) ⇒ results are “reasonable”

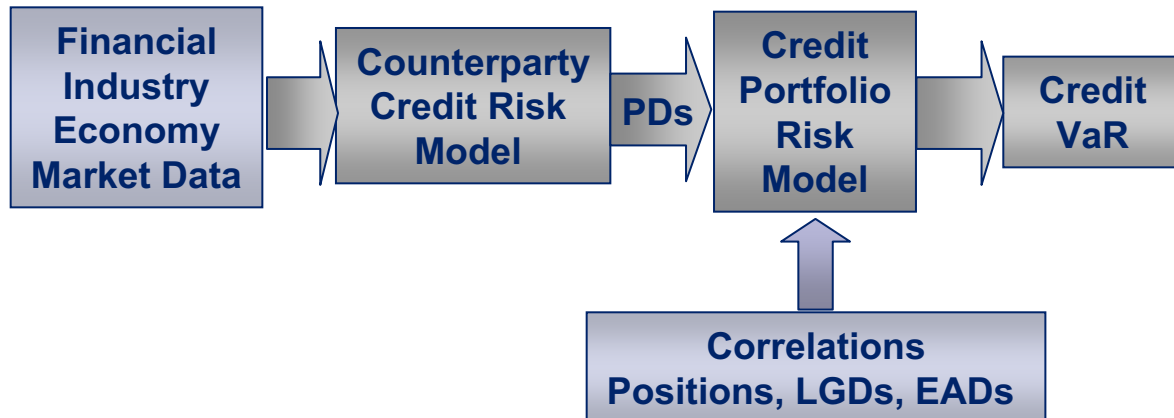
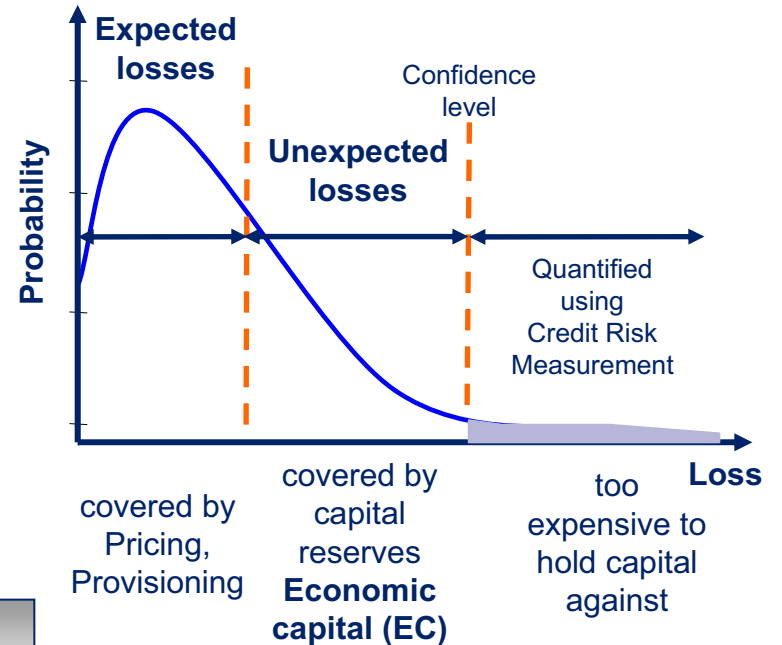
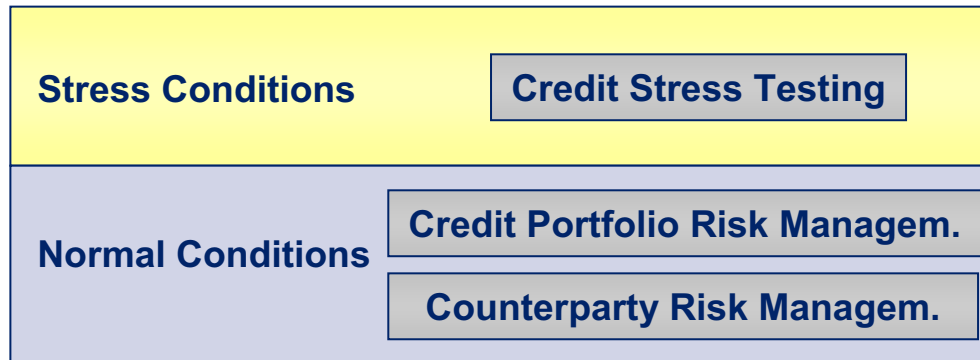
# Risk Classification



# Loss Distribution, Provisions and Economic Capital



# Credit Risk Measurement Approach



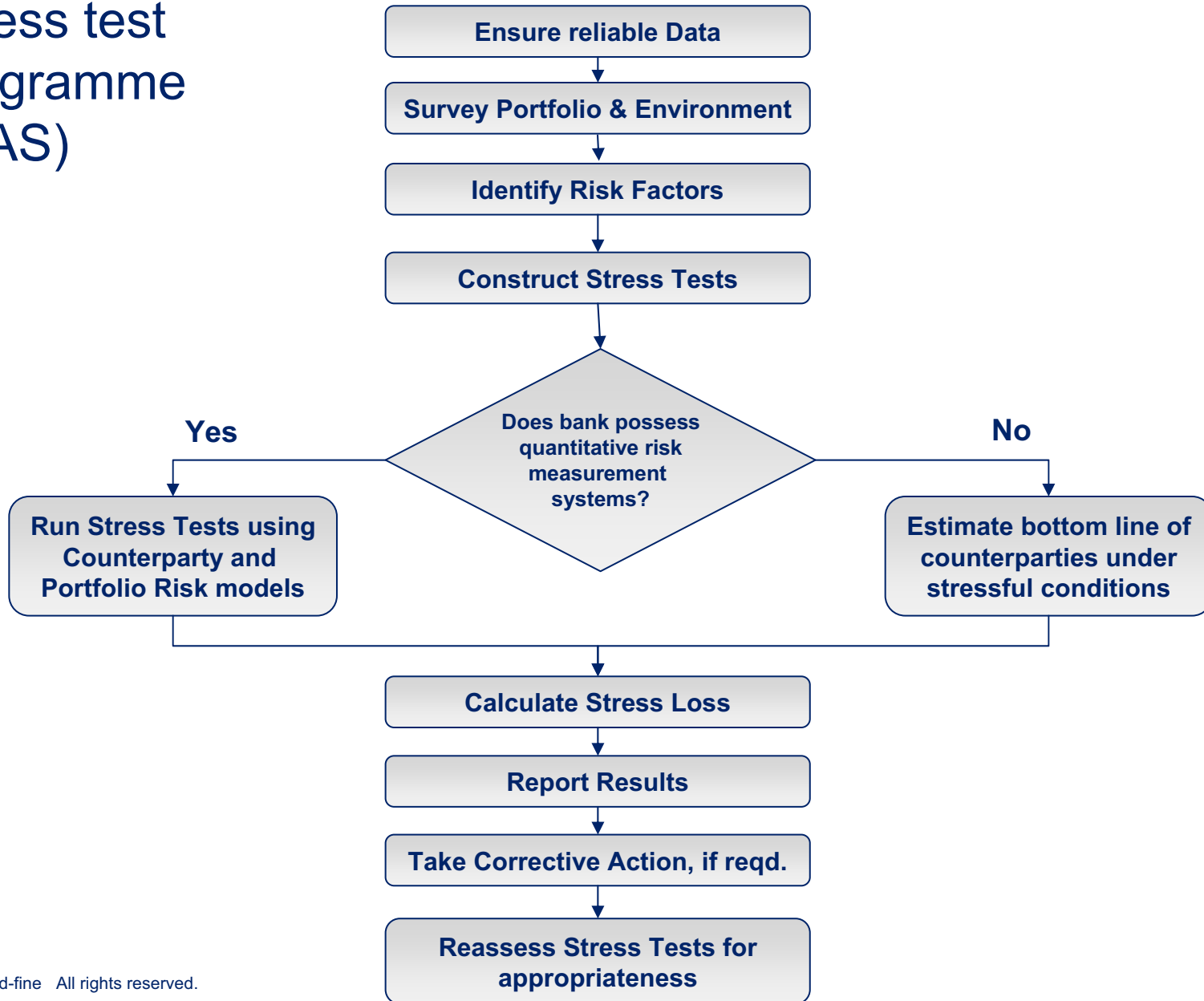
## Common Practice

- ❑ Ad-hoc / Expert Judgment
  - Ask the portfolio managers or work-out head
    - Portfolio run-off / bond market disintermediation
    - Best case / worst case scenario
  
- ❑ Direct Historical Inference
  - Economic cycles: recessions
    - Expected Loss & Net Charge-off Estimation
  - Migration Matrix
  
- ❑ Bi-variate Macro Estimations
  - Historical Default rates vs. GDP
  - Job vacancies vs. Unemployment

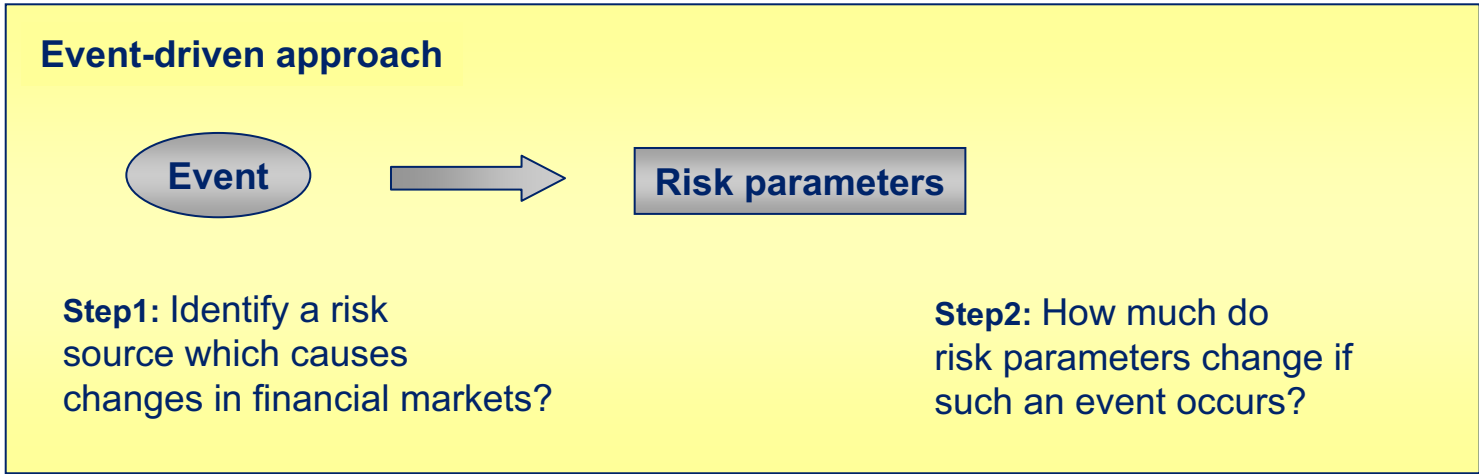
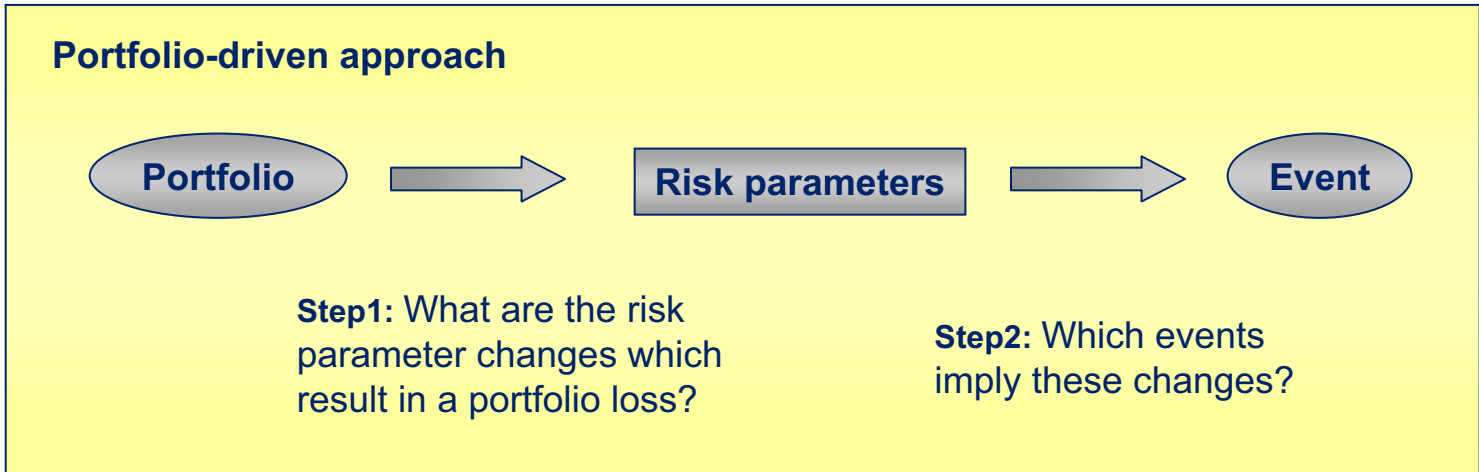
## Common Practice & typical Problems

- ❑ Observed singular stress event
  - “Worst annual internal experience”
  - Broad default rate movements (peak / trough)
  - Equity market crash
  - Widening credit spreads
- ❑ Arbitrary shocks
  - e.g. impose a two-grade downward migration across the portfolio.
- ❑ Stress key parameters
  - e.g. increase all PDs, LGDs or correlations by 25%, 50% or 100%.
- ❑ Relevant data often not incorporated
  - e.g. internal transition matrices, internal economic projections, historical parameter behaviour
  - correlations between LGD and PD
  - volatilities of LGD, EAD
- ❑ Missing
  - Portfolio Dynamics
  - Economic Dynamics; multi sector correlations

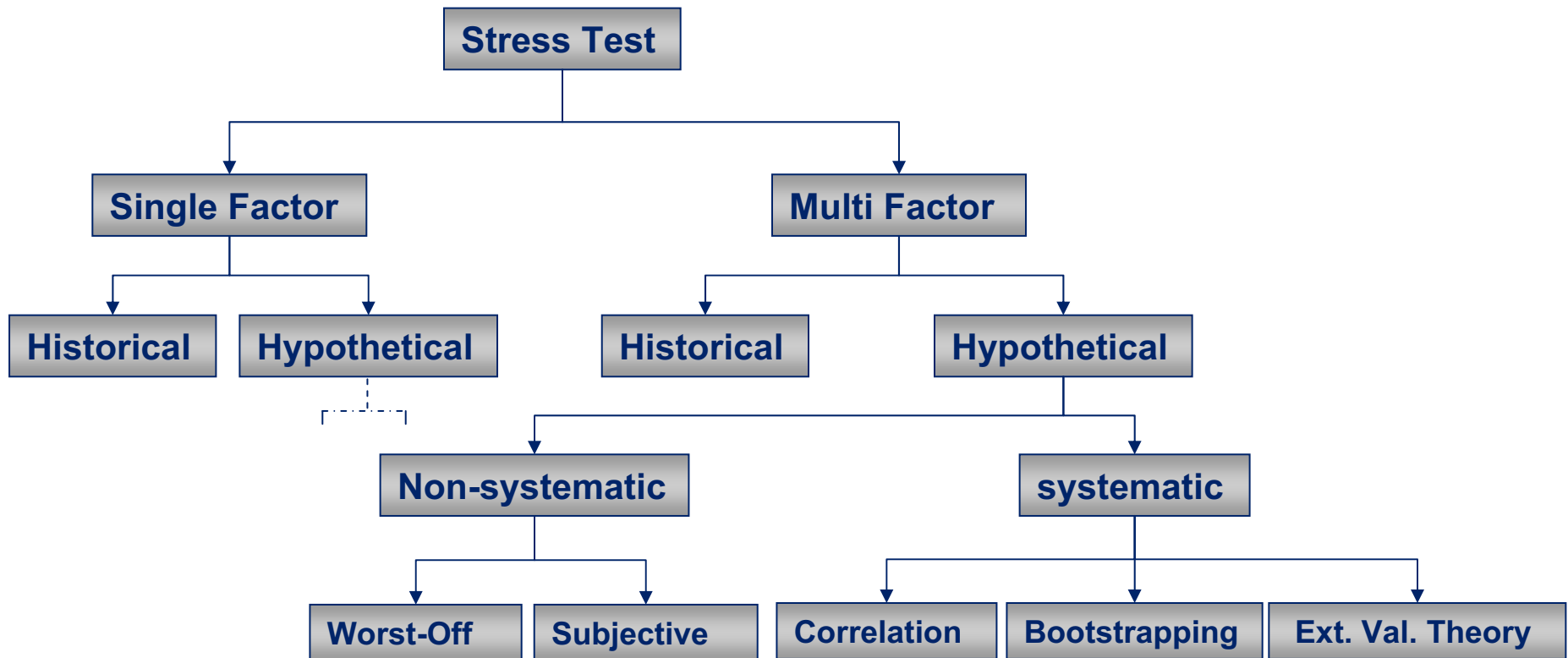
# Stress test programme (MAS)



# Approaches to Scenario Formulation

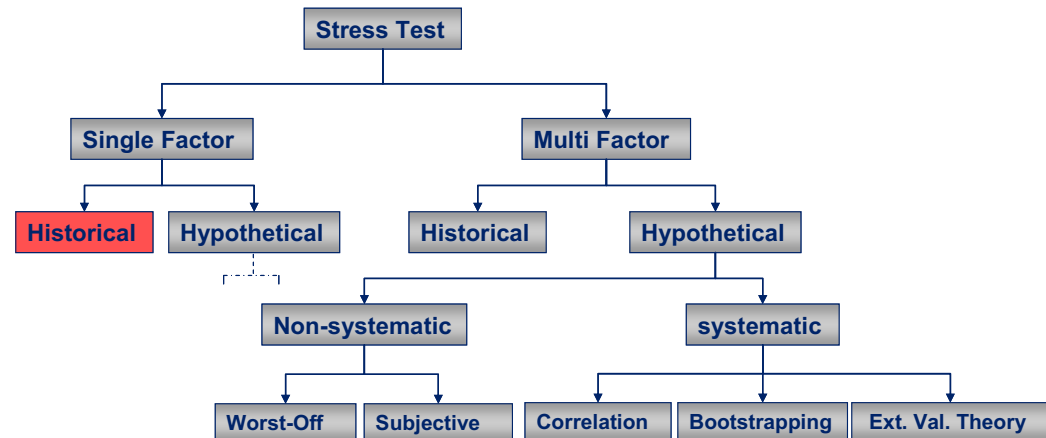


# Constructing Stress Tests

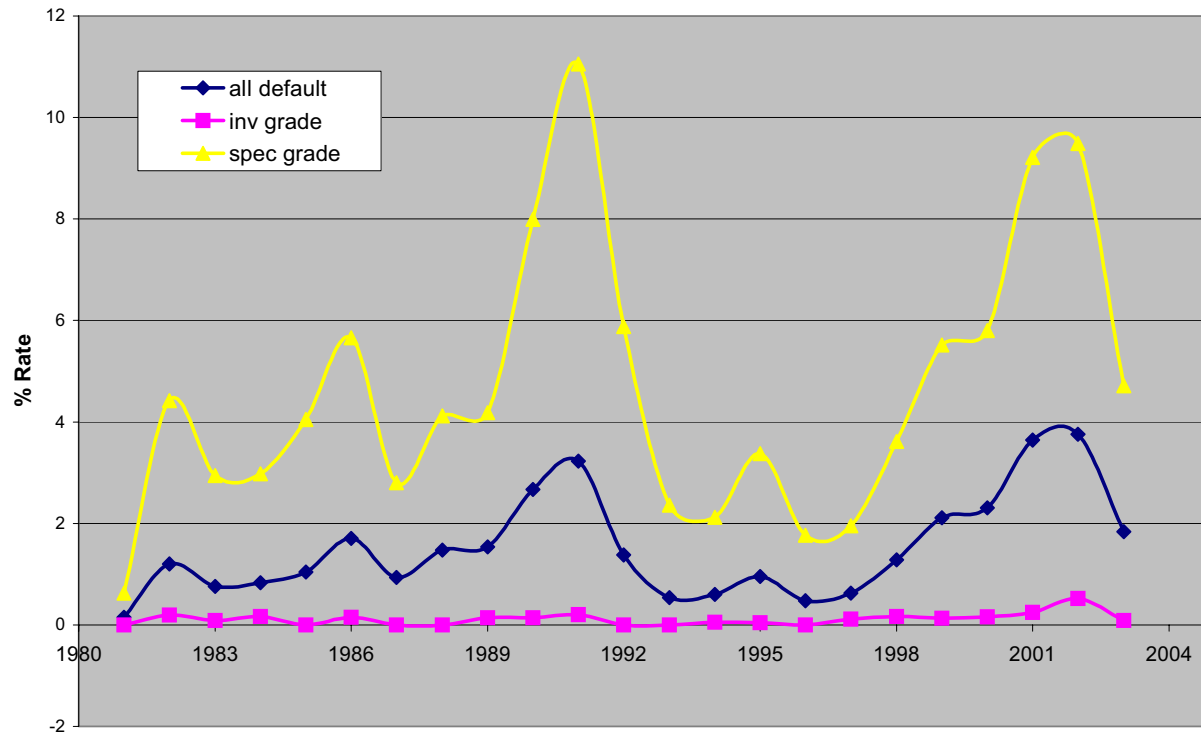


## Example

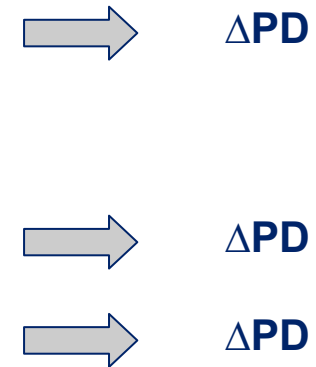
- ❑ Single factor
- ❑ Historical events
- ❑ Corporate portfolio
- ❑ Stress PD



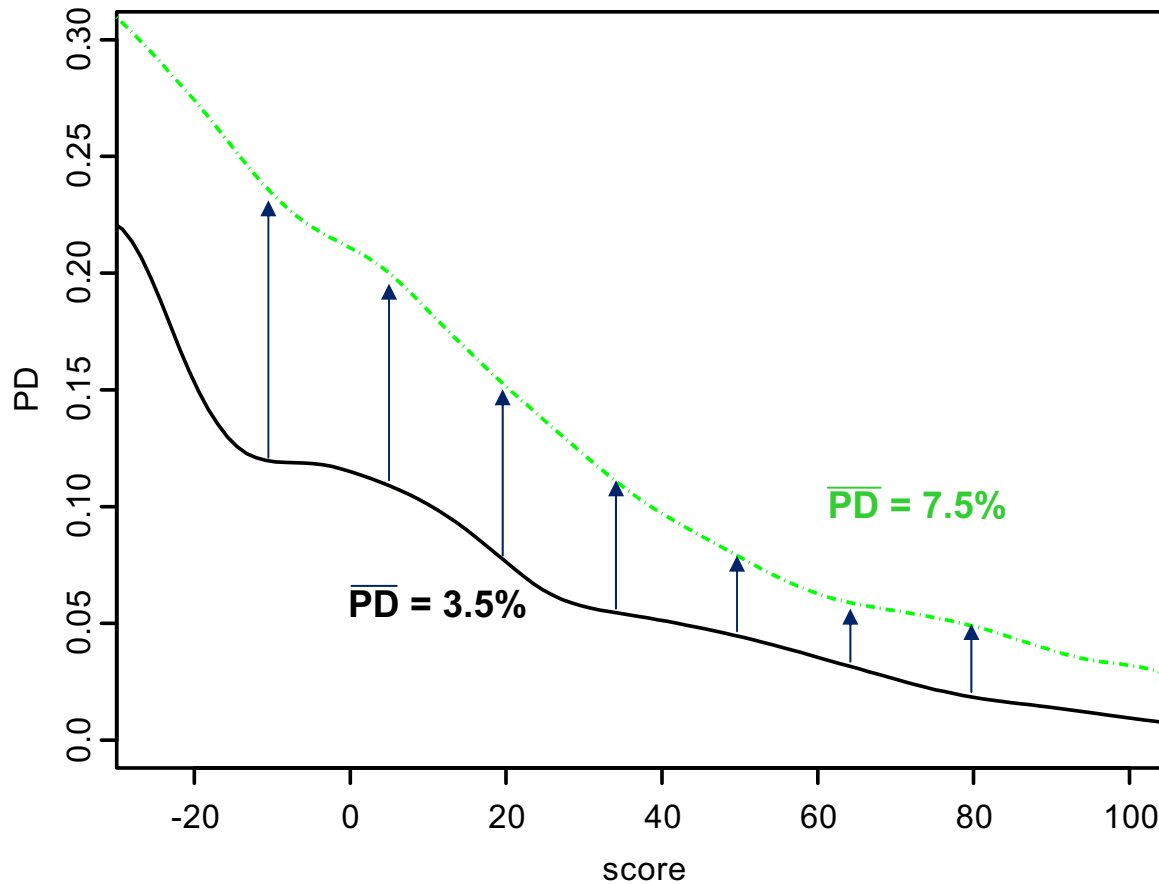
# Example: Historical Default Rate



Source: S&P Annual Default Study 2004



## Example: Increase average PD (industry specific)



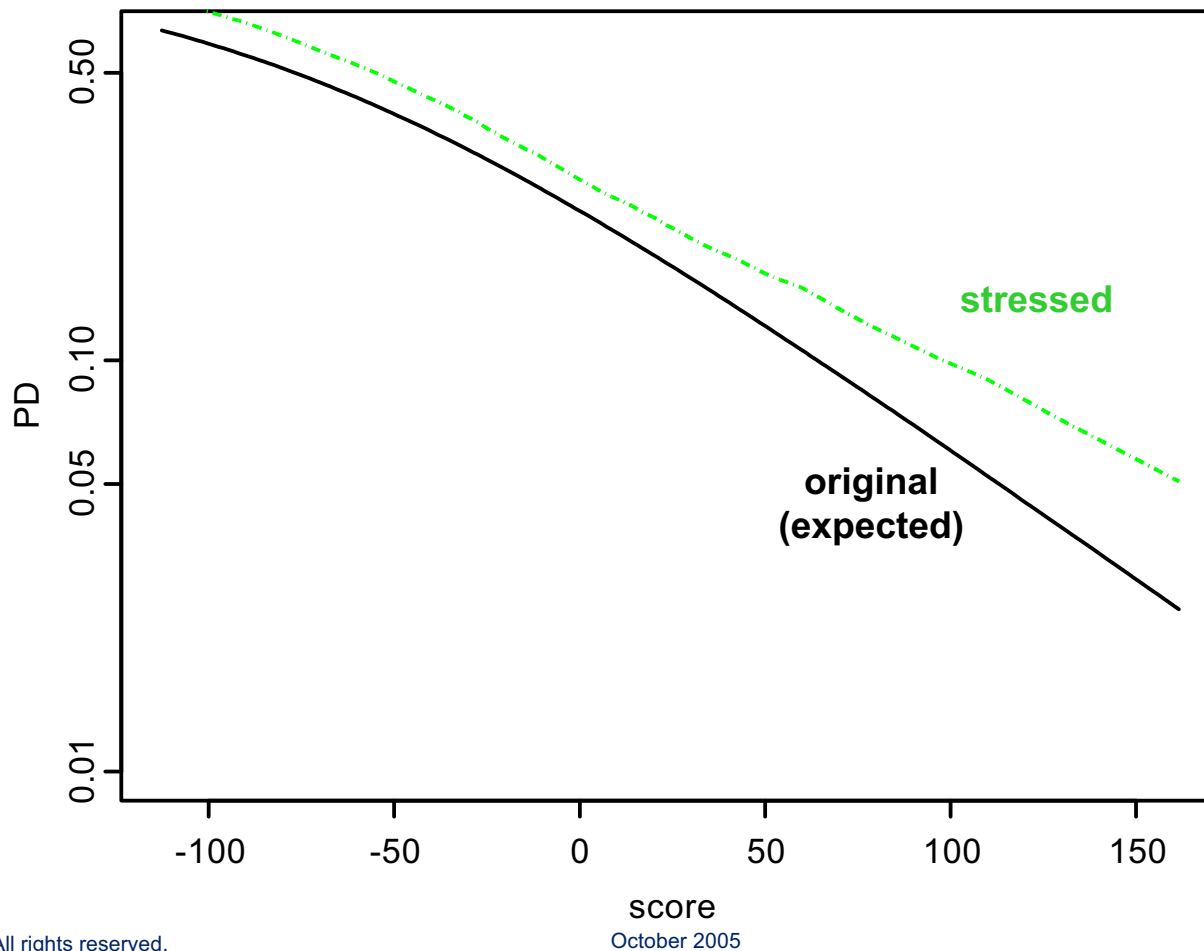
$$PD = \frac{1}{1 + \exp(\alpha + \sum_i x_i \beta_i)}$$

### Calibration

$$\overline{PD} = \frac{1}{1 + \exp(\alpha)} \Leftrightarrow \alpha = \ln\left(\frac{1 - \overline{PD}}{\overline{PD}}\right)$$

## Example: Hypothetical Default Rates

- Bootstrap PD from default rate shifts observed during historical stress events

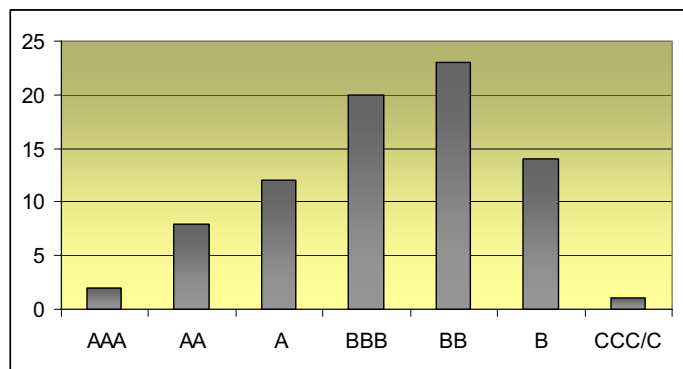


# Example: Stress Transition Matrix

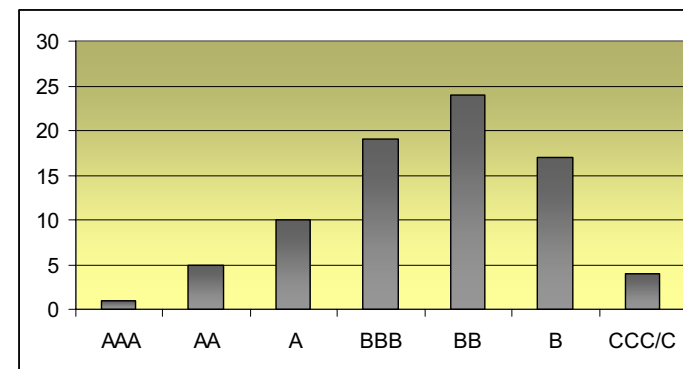
- Historical event:
  - e.g. Changes in S&P's transition matrices from 2001 to 2002

	AAA	AA	A	BBB	BB	B	CCC/C	D	NR
AAA	-6.19	4.36	0.63	1.25	0	0	0	0	-0.03
AA	0	-8.73	6.16	2.05	0.17	0.34	0	0	0
A	-0.08	-1.61	-1.24	3.75	0.65	0.16	-0.26	-0.17	-1.19
BBB	-0.08	-0.08	-0.53	-1.7	1.82	1.45	-0.3	0.79	-1.36
BB	0.11	0.23	-0.11	0.29	4.26	-1.51	-1.09	0.18	-2.37
B	0	0	-0.11	0.49	1.99	3.34	0.72	-2.34	-4.08
CCC/C	0	0	0.58	0	1.16	-0.02	-5.79	0.29	3.77

**Current Portfolio**



**Stressed Portfolio**



## Stress testing requirements within Basel II

434. An IRB bank must have in place **sound stress testing processes** for use in the assessment of capital adequacy. Stress testing must involve **identifying possible events or future changes in economic conditions** ... Examples of scenarios that could be used are

- (i) economic or industry downturns;
- (ii) market-risk events; and
- (iii) liquidity conditions.

435. ...**credit risk stress tests** ... meaningful and reasonably conservative. ... consider at least the effect of mild recession scenarios. ... not to require banks to consider worst-case scenarios...

436. ... a bank's own data should allow estimation of the **ratings migration** of at least some of its exposures. ... smaller deterioration in the **credit environment on a bank's ratings**, giving some information on the likely effect of bigger, stress circumstances. ... **ratings migration in external ratings**. ...

437. National supervisors may wish to issue guidance...

## Summary

- ❑ Purpose of Stress Testing
- ❑ Types of Stress Testing
- ❑ Stress Testing: Approach & Examples
  - Risk Classification & Measurement
  - Common Practice
  - Systematic Approach
  - Examples
- ❑ Basel II requirements

## Literature

- ❑ Stress testing at major financial institutions: survey results and practice [www.bis.org/publ/cgfs24.pdf](http://www.bis.org/publ/cgfs24.pdf) (January 2005)
- ❑ Stress-testing financial systems: an overview of current methodologies [www.bis.org/publ/work165.pdf](http://www.bis.org/publ/work165.pdf) (December 2004)
- ❑ Monetary Authority of Singapore: technical paper on credit stress testing (March 2003) [www.mas.gov.sg](http://www.mas.gov.sg)
- ❑ Bank of Finland, discussion paper 4/2004, S. Peura & E. Jokivuolle, Simulation based stress testing of banks' regulatory capital adequacy [www.bof.fi](http://www.bof.fi)
- ❑ IMF working paper, WP/04/127, stress testing the financial systems: What to do when the governor calls, T. Jones, P. Hilbers and G. Slack [www.imf.org/external/pubs/ft/wp/2004/wp04127.pdf](http://www.imf.org/external/pubs/ft/wp/2004/wp04127.pdf)

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