Credit Risk Stress Testing for the Mexican Banking System

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Outline

I. CyRCE

II. Stress Testing

CyRCE: Properties

A closed form default model assuming that the loan portfolio loss distribution can be characterized by its mean and its variance:

- Closed form expression for Value at Risk (VaR):
  - Explicit management controls: Capital adequacy, single obligor limits, etc.
  - Portfolio Analysis: Risk concentration, allocation, pricing, optimization.
  - Great computational efficiency: Large portfolios, fast feedback.
  - Limited portfolio information.
- Explicit parametrization of all relevant credit risk elements:
  - Deal with information gaps through assumptions.
- **Easy stress testing.**

CyRCE: A General Model

1. Let f_i denote the i th loan amount in the portfolio; $i = 1,2,....,N$

$$\mathbf{F} = (f_1, ..., f_N).$$

2. All loans have different default probabilities:

$$\pi = (p_1, ..., p_N).$$

3. Loan defaults can be correlated : covariance matrix.

$\sigma_{i,j}$ = Default Covariance between loan i and loan j $= \sigma_i \sigma_j \rho_{i,j} = \mathbf{M}_{i,j}$

$\rho_{i,j}$: default correlation between loan i and loan j

CyRCE: Value at Risk

The *value at risk* with confidence level α is given by:

$$VaR^{\alpha} = V\left(\frac{\pi^{\mathrm{T}}\mathbf{F}}{V} + z_{\alpha}\sqrt{\frac{\mathbf{F}^{\mathrm{T}}\mathbf{M}\mathbf{F}}{\mathbf{F}^{\mathrm{T}}\mathbf{F}}H(F)}\right)$$

Value of the portfolio

$$V = \sum_{i=1}^{n} f_i$$

Expected loss relative to the value of the portfolio.

Confidence Level Factor

Rayleigh's Quotient

Loss variance relative to the "size" of the portfolio.

HHI

Concentration index

By assuming a gamma distribution, VaR estimates are comparable with the ones obtained with CreditRisk+ and Creditmetrics™.

CyRCE: Value at Risk per segment

The portfolio can be segmented arbitrarily and a *value at risk* expression for each segment *j* per segment is given by:

$$VaR_j^{\alpha} = V_j \left(\frac{\pi^T F_j}{V_j} + z_{\alpha} \phi \sqrt{R(F_j, M_j) H(F_j) + \sum_{i \neq j} \frac{F_j^T C_{i,j} F_i}{V_j^2}} \right)$$

Value of the loans in segment *j*

Weighted average default probability of the loans in segment *j*

Rayleigh's quotient* for segment *j

HHI_j

Adjustment for Extra group Covariance

ϕ **is an adjustment factor such that:** $\sum_j VaR_{\alpha}^j = VaR_{\alpha}$

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Using the model for Credit Stress testing

- There is a ***lag*** between Credit and Market risk shocks.
- In our experience, it takes a very severe crisis (time and depth) before the impact reflects on credit.
- The economy's imbalance may span several years, so that stress tests are done over ***long time horizons***.
- There is no consensus* whether default volatilities and correlations are larger in a stress period.

*A survey of stress tests and current practice at major financial institutions. BIS CGFS 2001

Understanding the losses in Market and Credit shocks

There is a difference in how Market and Credit losses are realized:

- A credit loss is realized when ***a default occurs***, rather than by being forced to sell underpriced assets.
- In market risk, the loss can be ***avoided*** if a position can be held until the market disturbance disappears.

Designing the Stress Scenario

- When constructing a stress Scenario, the first step is **identifying events** that could have adverse effects on Banks' credit exposures, such as:
  - Economic downturns
  - Market events

- The way the stress event will be identified depends on the type of scenario chosen: Historical or hypothetical
- The second step is to determine how the occurrence of the event affects the risk factors and then **shock** the current portfolio to perform the risk analysis under these conditions.

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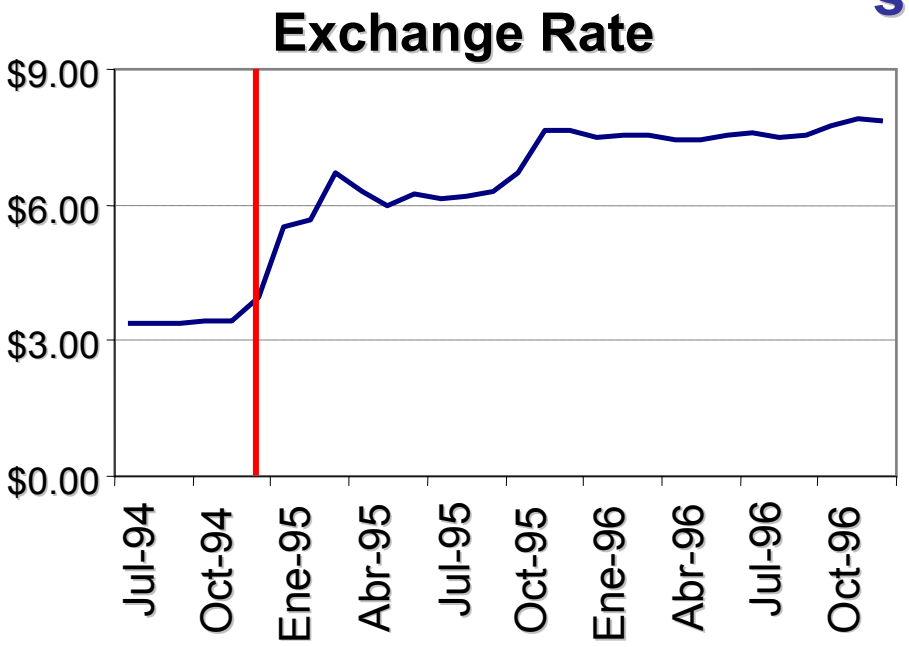
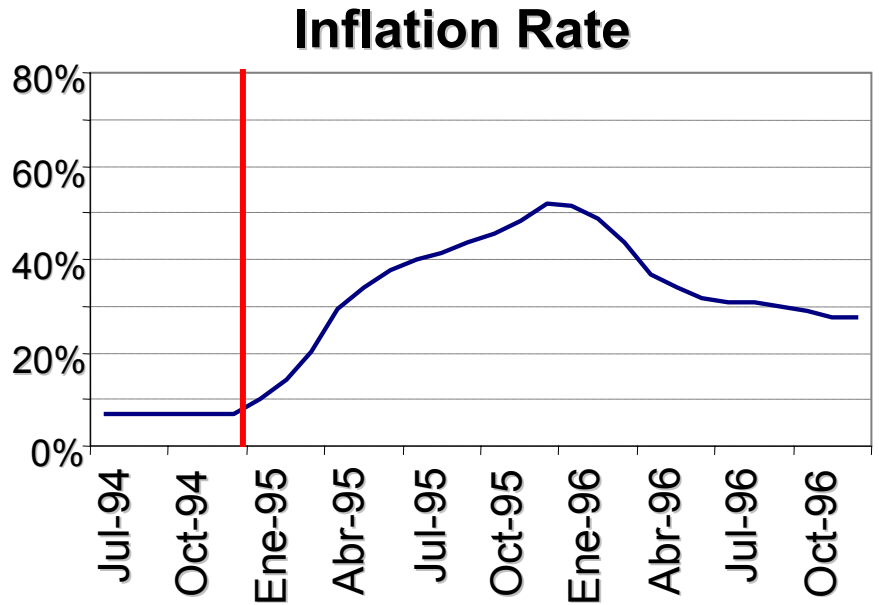
1. Historical scenario
2. Main results

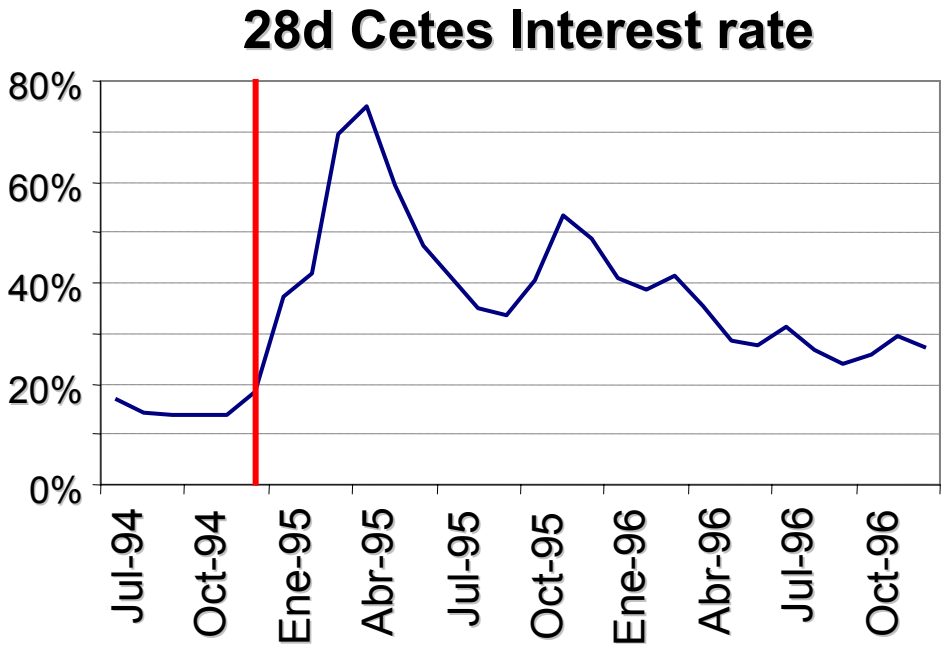
The Stress Scenario used: 1994 Mexican Crisis

- Along with the political turmoil, there was an unsustainable current account deficit and a substantially overvalued currency.
- On December 19th, the Government devalued its currency. Eight days later, the exchange rate had risen 66% from $3.47 to $5.76 MXP per USD.
- Simultaneously, the interbank short-term interest rate rose 60% from 20.17% to 32.38% by December 22nd.

The Economy entered an inflationary period and the Central Bank switched to a free-floating currency.

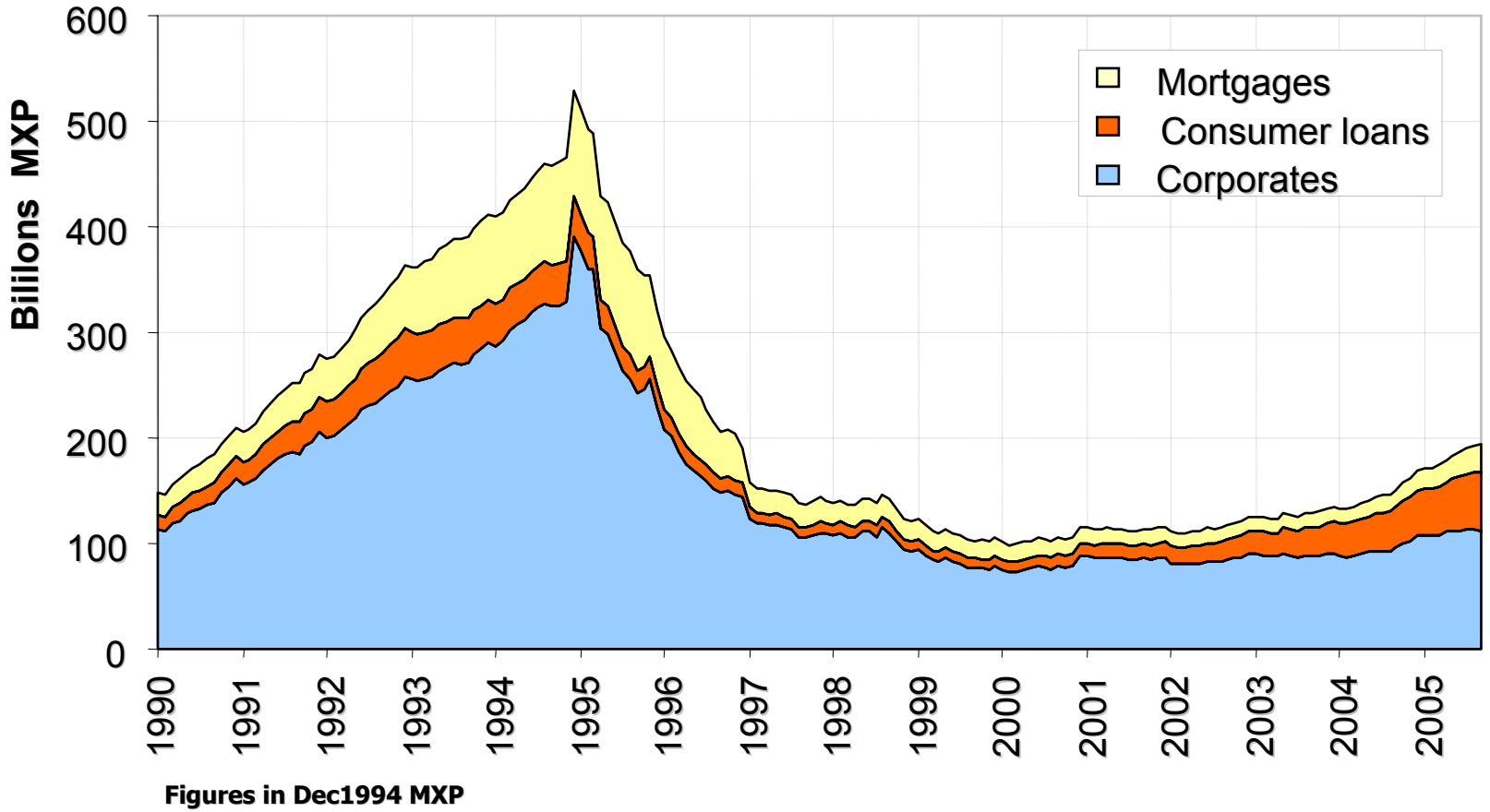






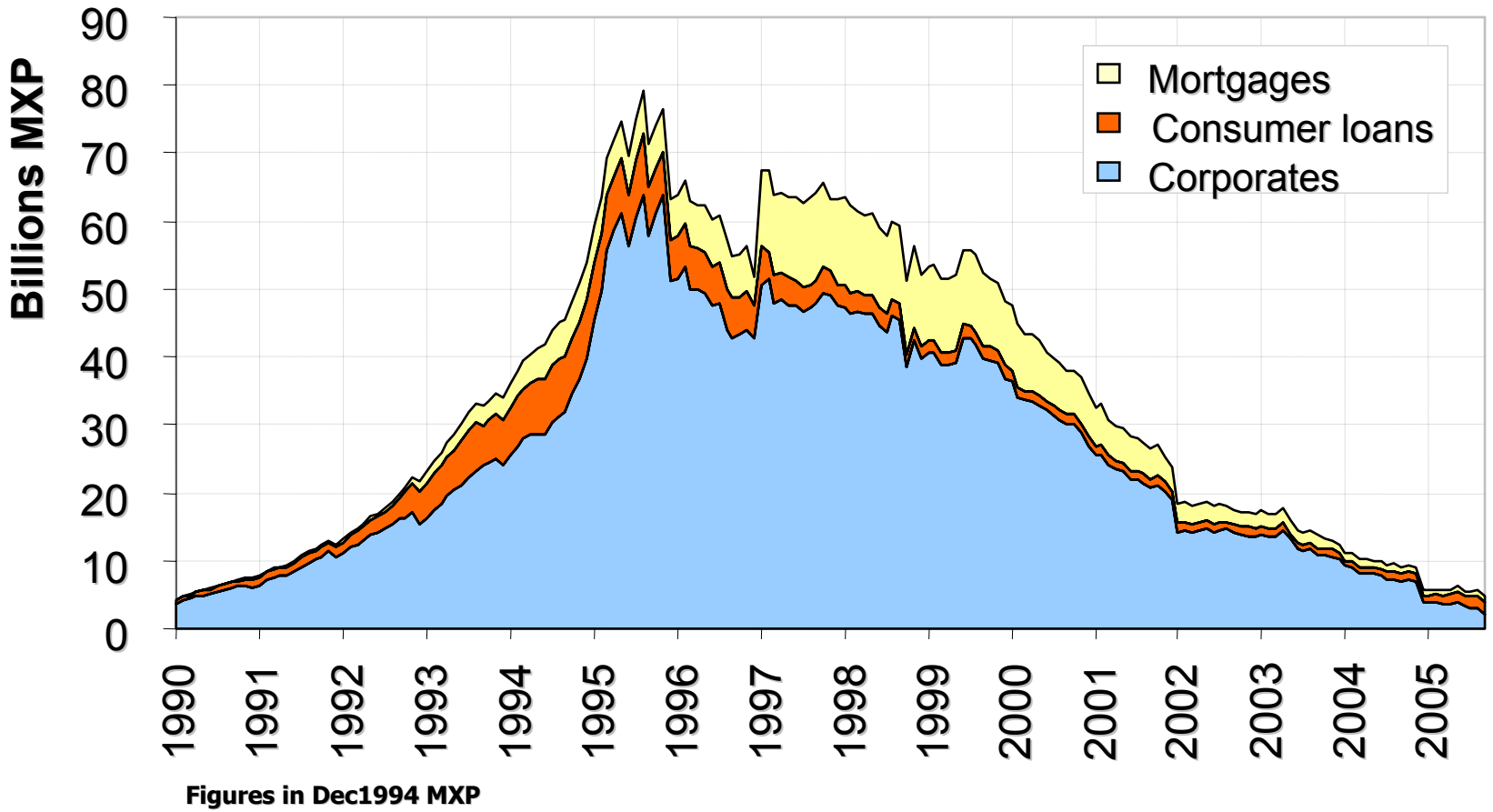
Performing Credit portfolio Value

- Inflation, rising interest rates and a devalued currency were the preamble for defaulted loans and an abrupt halt in credit activity.



Non-performing loans Value

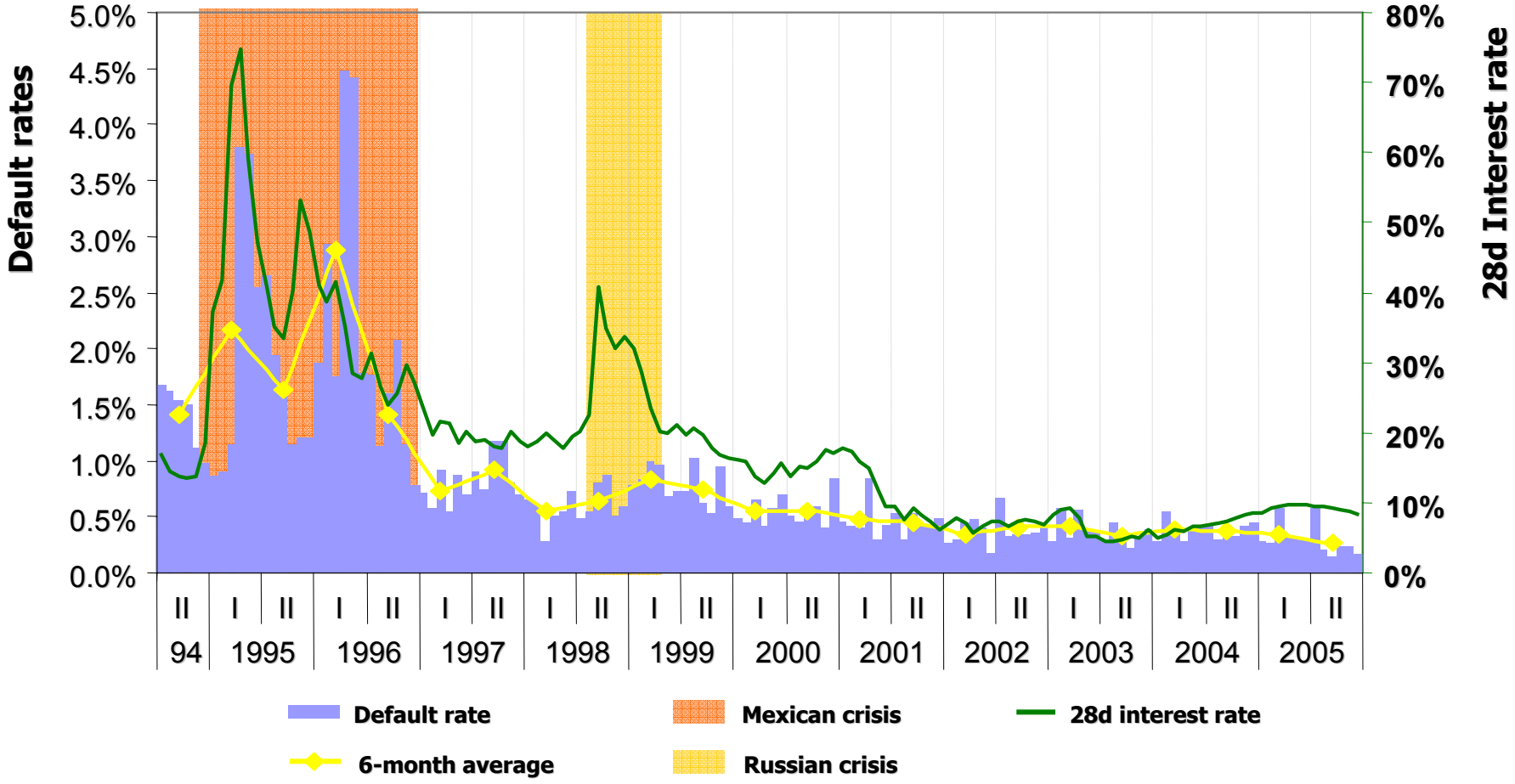
- **Non-performing loans increased 60% in 1995, even after the government acquired the distressed debt of the most troubled banks.**



Figures in Dec1994 MXP

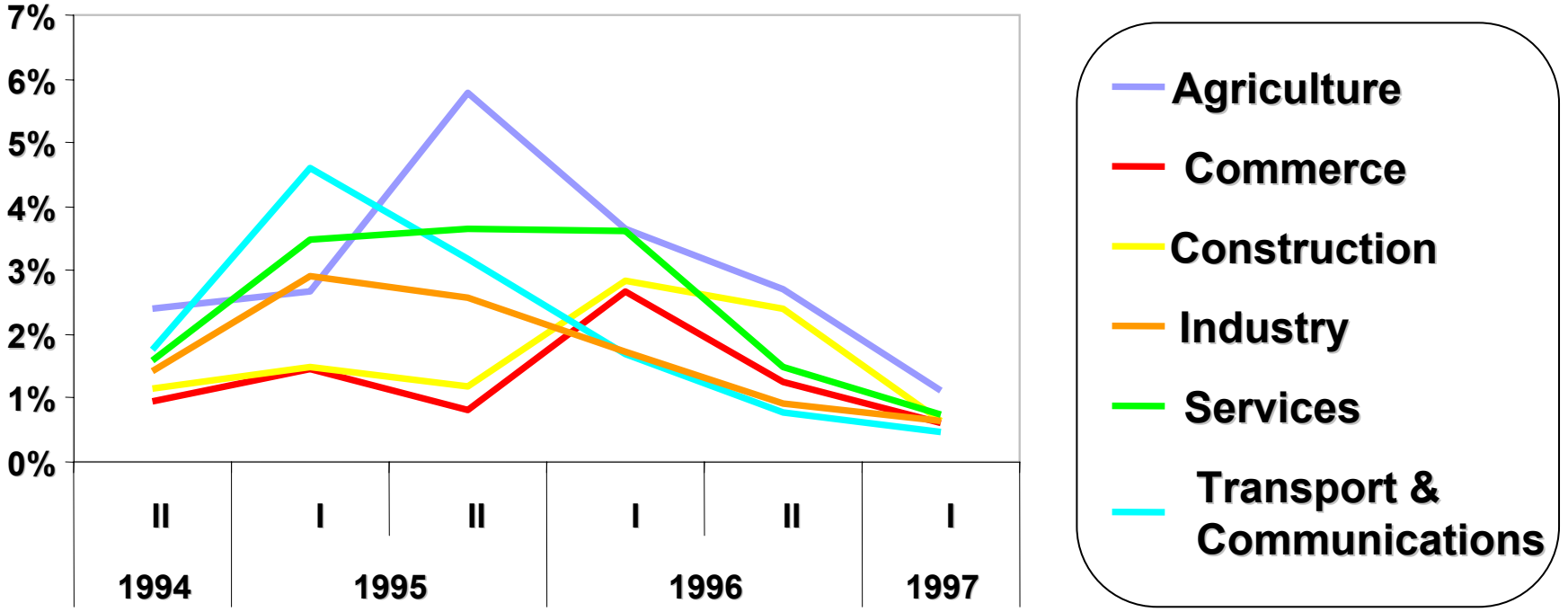
Corporate Default rates

- **In the corporate portfolio, Default rates increased by 3 times the 1994 levels.**



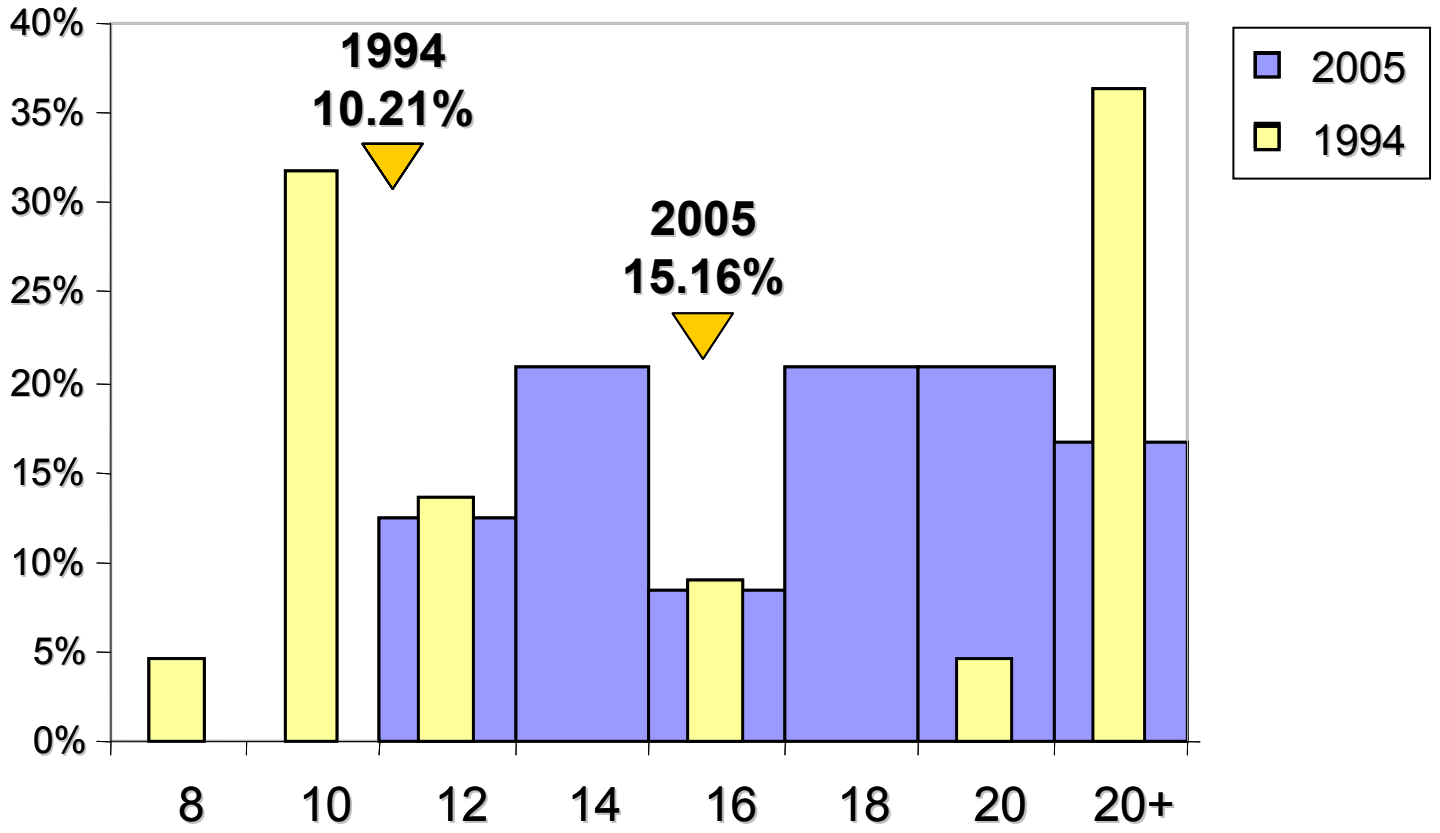
Default rates by economic sector

- The first economic sectors to exhibit a rise in default rates were the Agricultural, Transportation and Communications and Industrial sectors. Construction and Commercials were the last to react. Services exhibited high default rates over the 18 month stress period.



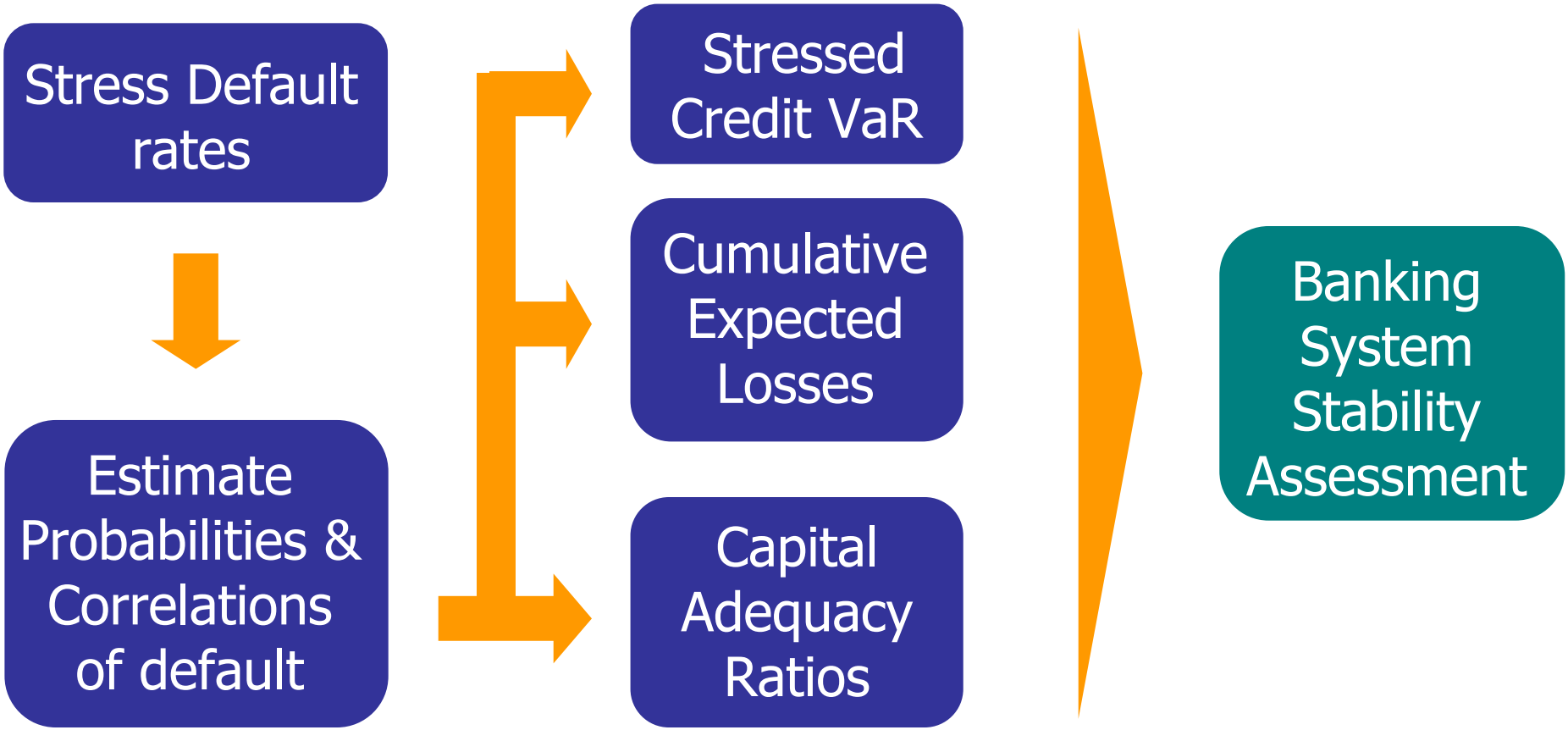
Capital Adequacy Ratio (CAR)

- The economic and financial situation is different from that of previous crisis periods: banks are better capitalized and most loans are fixed rate.



Stressing Credit Risk

- **Schematically, the design of the stress test is given as follows:**



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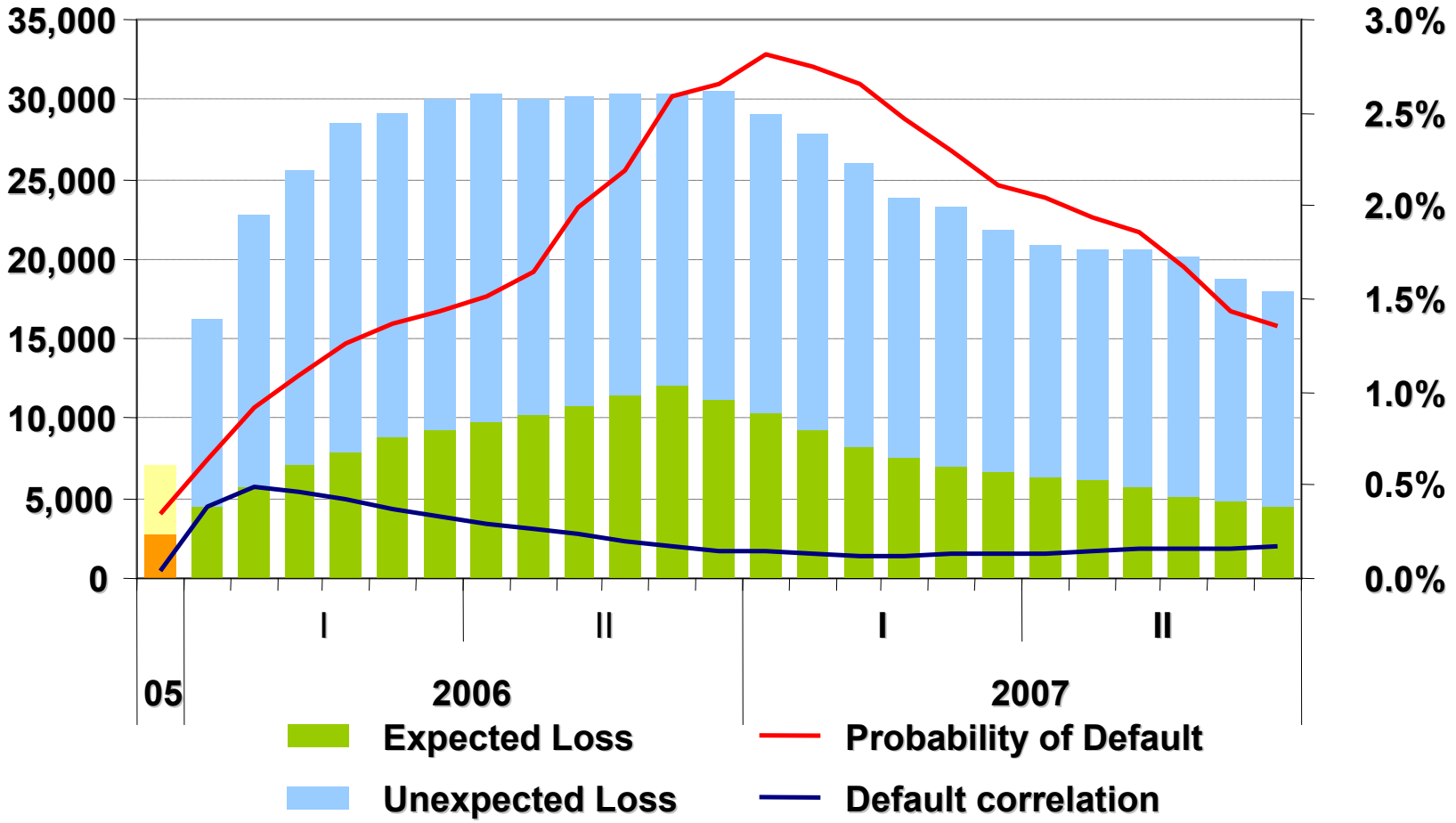
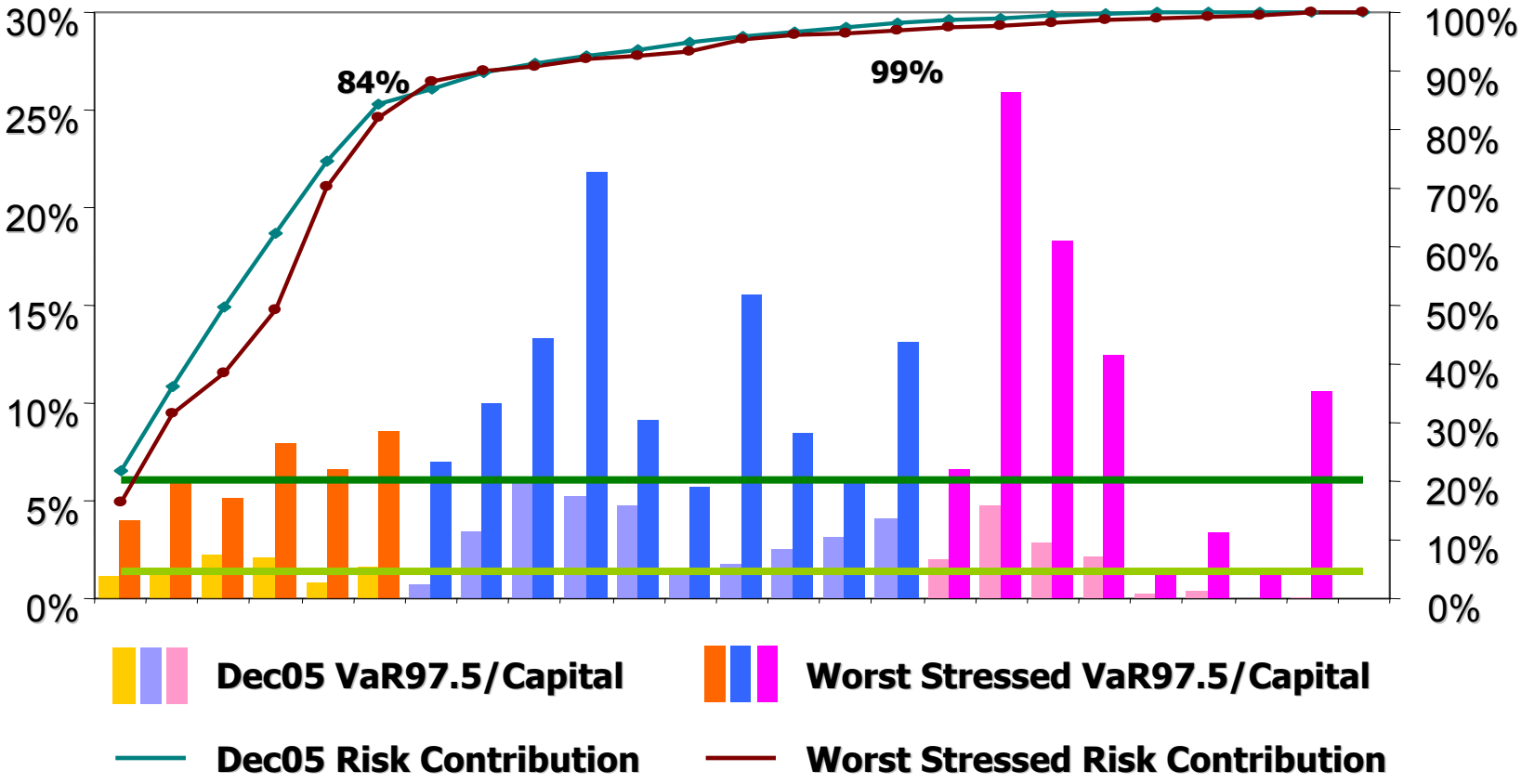
Value at Risk over a Stress period

- The Value-at-risk with a 97.5% confidence level under the stress scenario would be:

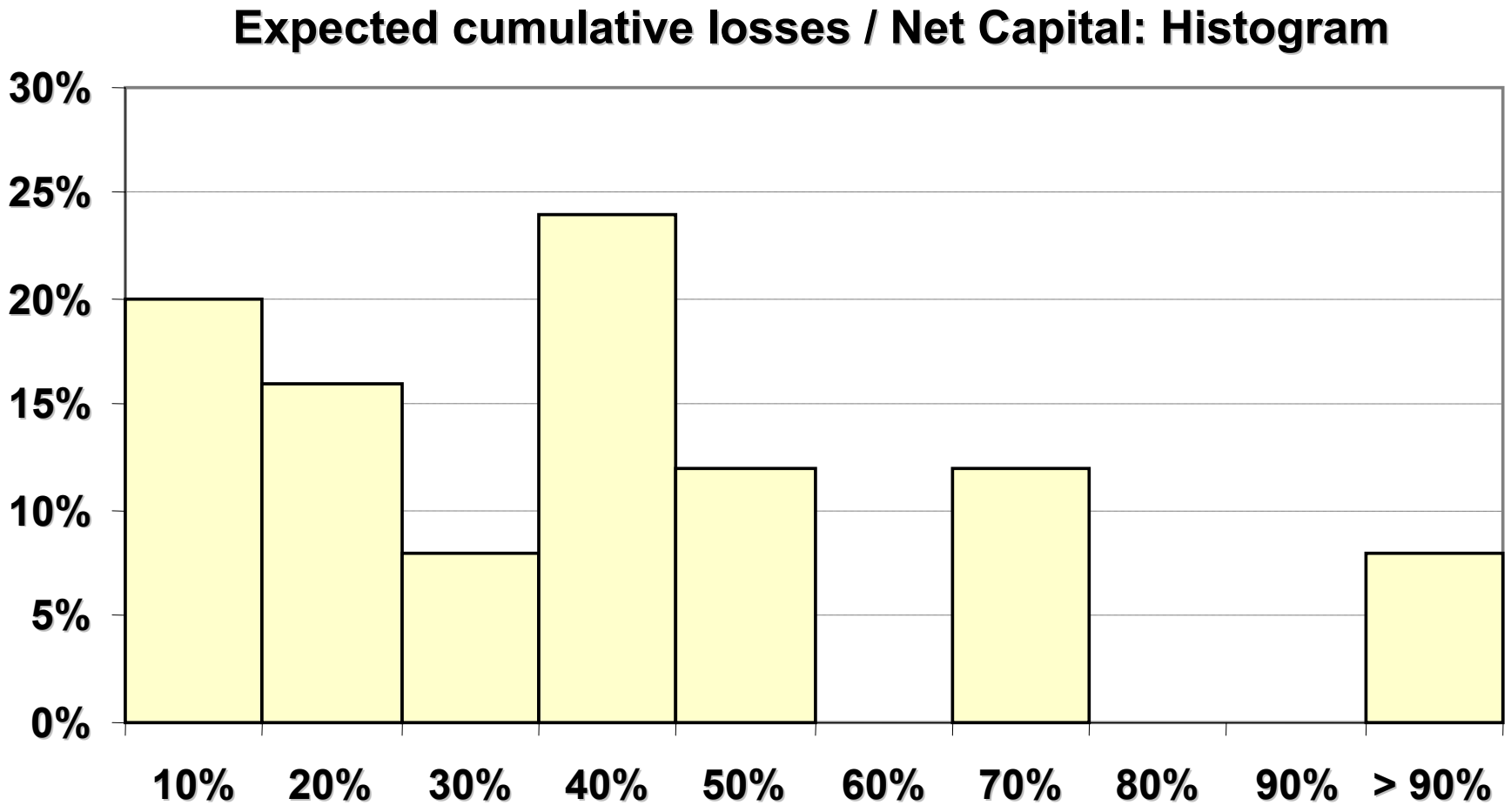


Risk contribution

- At the peak of the stress scenario, the risk contribution would be:

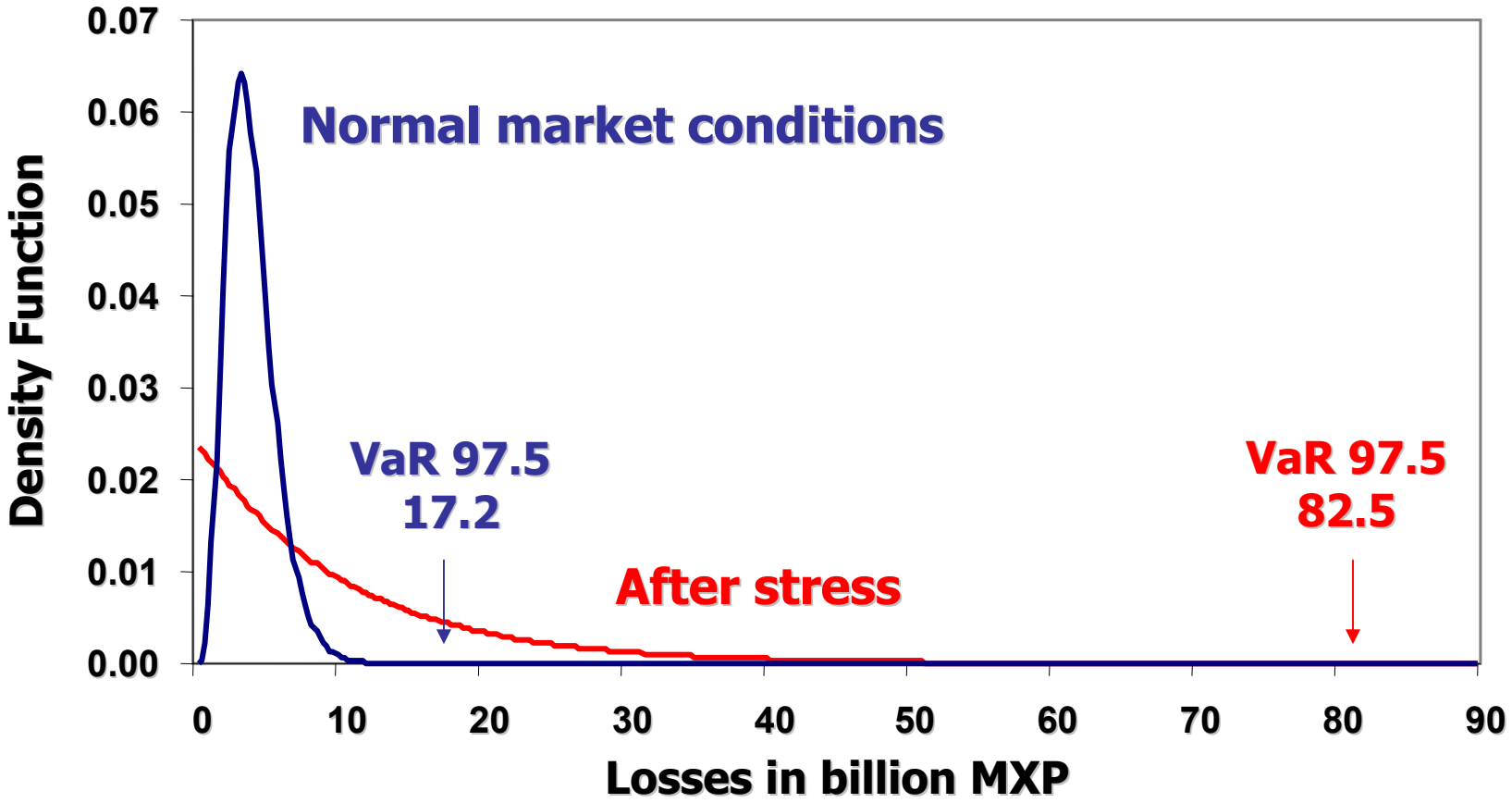


Expected cumulative losses

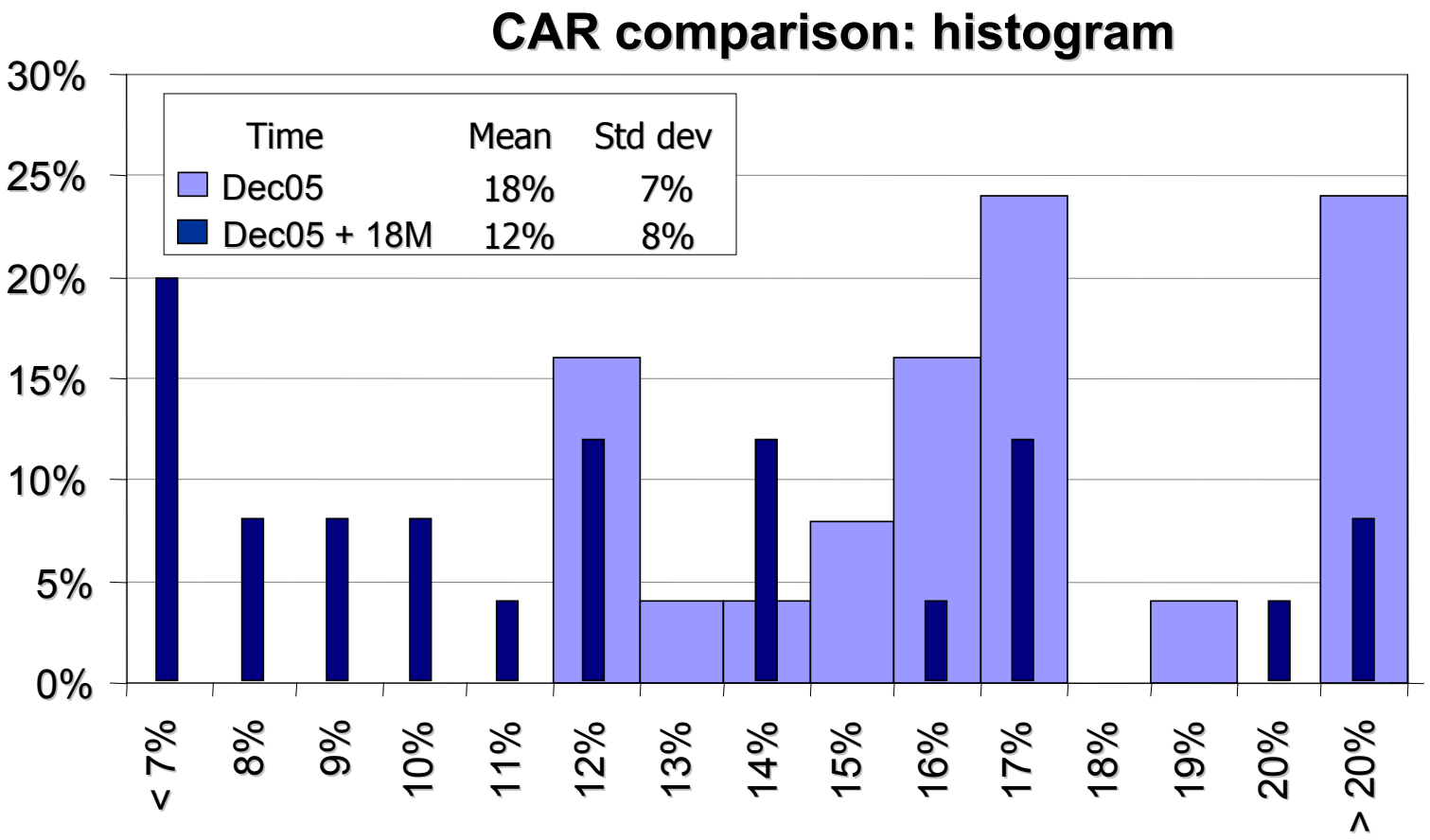


Loss Distribution Analysis

- The loss distribution for the first six months changes dramatically with respect to the loss distribution fitted before stress.

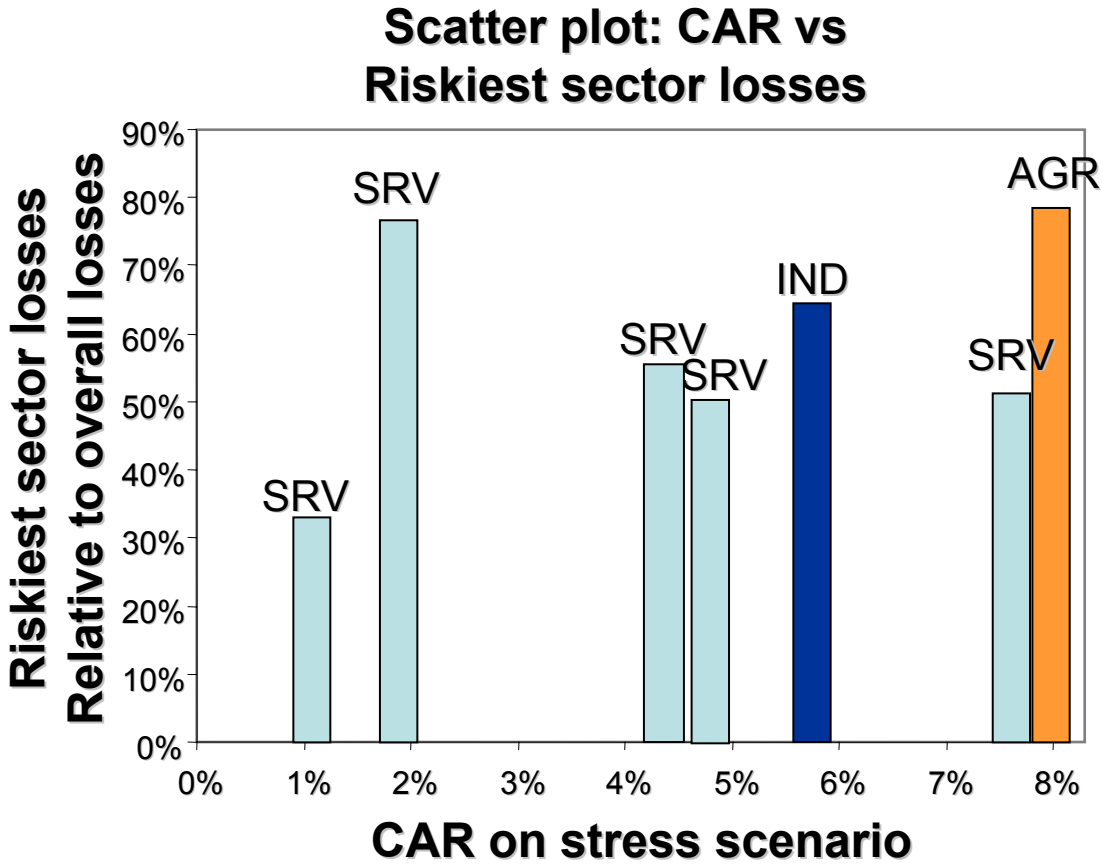


- **At the end of the scenario (18 months after its beginning), 20% of the banks show a CAR below 7%, while 8% of the banks show a CAR between 7 and 8%.**



Analysis of troubled banks

- Banks showing a CAR below the 8% threshold, were lending mainly in the services sector.
- Loans in the agriculture sector are backed by the government.



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