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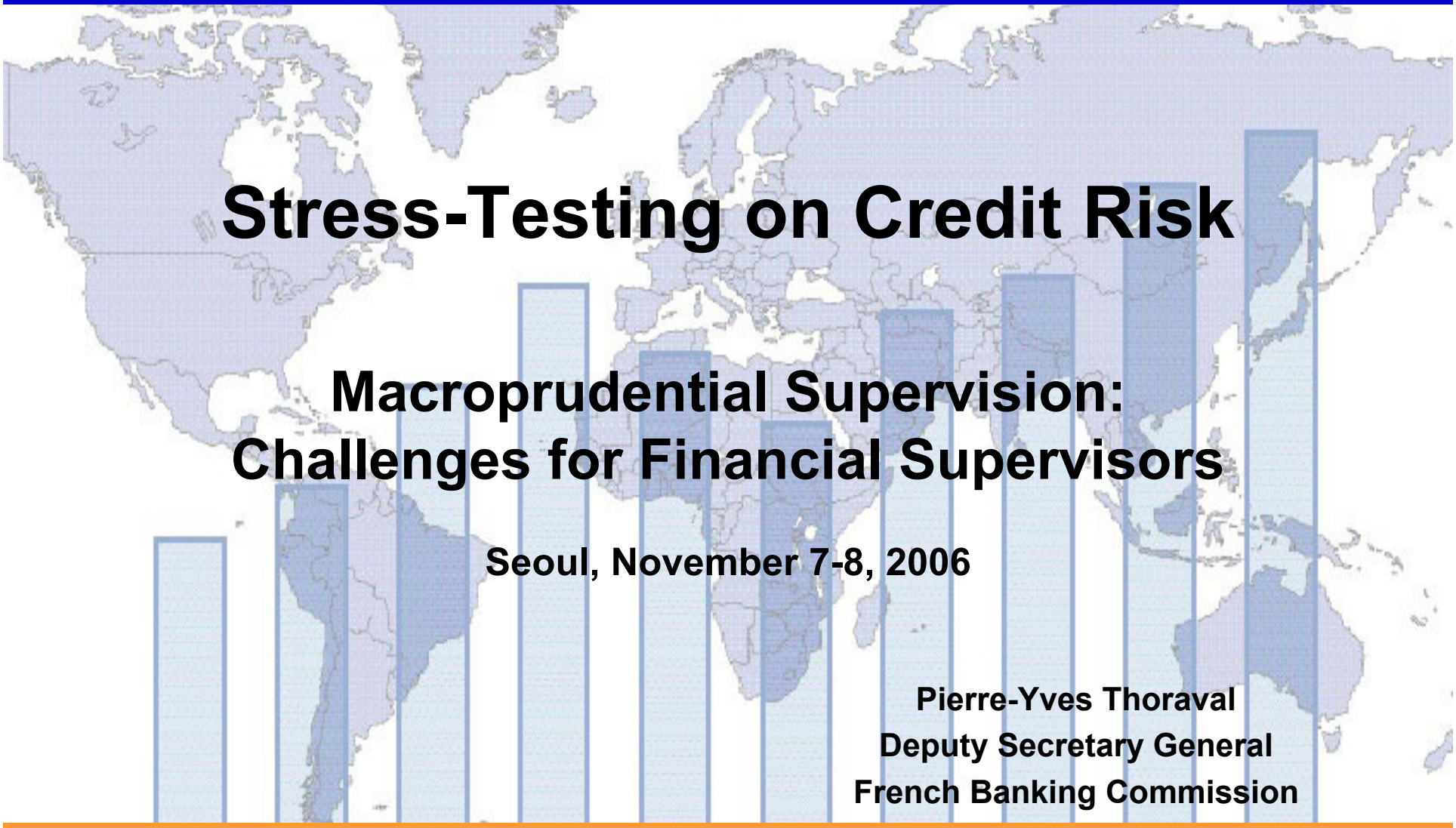

Stress-Testing on Credit Risk

Macroprudential Supervision: Challenges for Financial Supervisors

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Pierre-Yves Thoraval
Deputy Secretary General
French Banking Commission

Overview

1 . Introduction: Importance of stress-tests

2 . Survey of methodological approaches

3. French stress-tests on credit risk

4. Limits and prospects

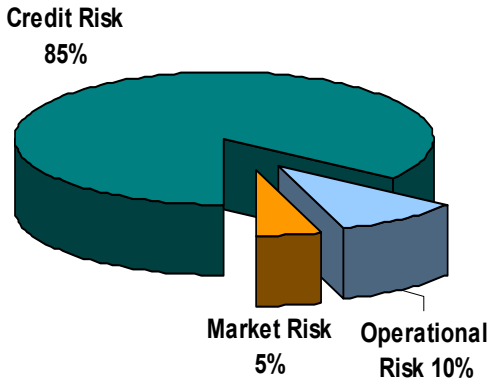
5. Conclusion

1 – Introduction: Importance of stress-tests

- Many changes have affected the international banking environment with the growing role of financial markets and globalisation

- Firms' failures and macroeconomic uncertainties have reinforced the attention paid to credit risk, considered as the key risk faced by banks (85% of bank's risks)

- When failing, the most risk-exposed banks did not generally hold sufficient capital



1 – Introduction: Importance of stress-tests

- The first lesson of these failures is the need of an intensification of credit risk monitoring, with new quantitative measurement instruments

- Macro stress-tests are one instrument of monitoring (a need in an FSAP context)

- It has led central banks and supervisors to develop stress-tests research and to perform them on a regular basis

2 – Survey of methodological approaches

1. Literature on credit risk: a quick review

- Initially, research focused on market risk (*RiskMetrics* from *JPMorgan* in 1994). Three model on credit risk were developed: the structural approach with firm's value model (Merton 1973), the statistical approach with rating agency data, the intensity approach (risk yield curve estimation).
- Credit risk model parameters are difficult to catch on (default correlation problems, availability of banking credit portfolio data, etc.). Only few banks have proposed operational softwares on credit risk (*CreditMetrics*, *CreditRisk+*, *KMV*, etc.)
- Michael Gordy from *the Board of Governors of the Federal Reserve System* worked on credit risk models and their further developments which were the starting point on the Basel accord reform (Pillar 1)

2 – Survey of methodological approaches

2. Application to credit risk: stress-test exercises

- Central banks and banking supervisors study the linkage between macroeconomic trends and financial stability on credit risk and banking resilience. Macro stress-tests on credit risk constitute an important element of macro-prudential policy.
- G10 countries use large-scale simulation on banks' loan portfolio though macroeconomic stress scenario to assess the soundness of the banking system.
- Central banks run stress-tests using mostly the same underlying credit risk models (rating transition matrices, Credit VaR, estimations of NPL, etc.). Further researches on modeling differ (studies on concentration risk at the BIS, on contagion effects at DNB, on liquidity risk at the BoE, etc.)

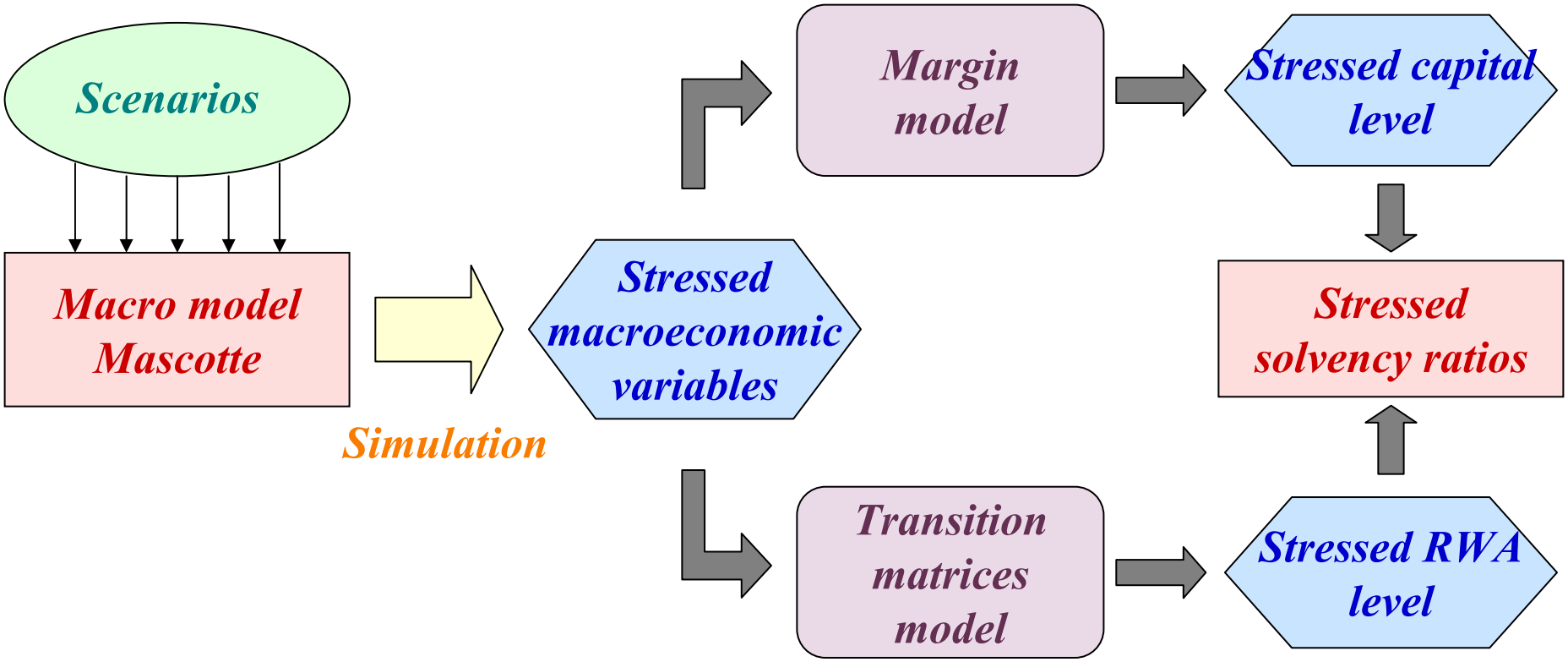
3 – French stress-tests on credit risk

Three approaches:

- Modelling macroeconomic stress scenarios on a loan portfolio
- Ad hoc shock on the credit portfolio of the major French banks
- Ad hoc shock on the EL of a single bank

3 – French stress-tests on credit risk

1. Modelling macroeconomic stress scenarios



3 – French stress-tests on credit risk

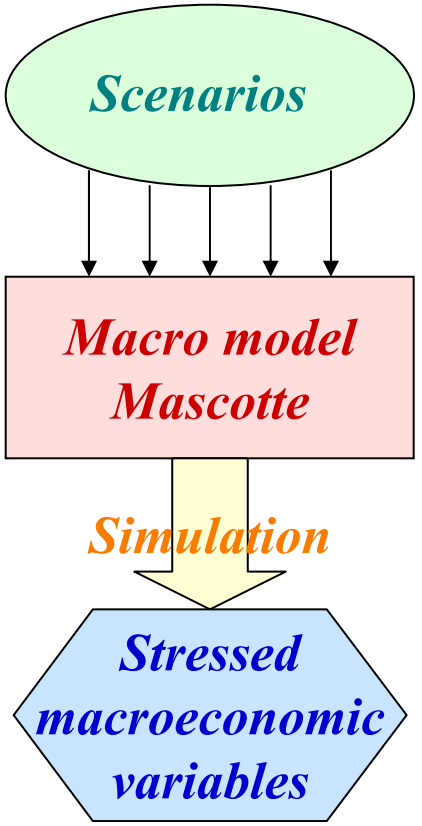
1. Modelling macroeconomic stress scenarios

- Different stress scenarios, inspired by FSAP scenarios:
  - 20 % drop in world demand for French goods
  - Rise in oil price to 100 USD
  - 30 % depreciation of USD/EUR
  - 200 base points parallel shift of interest rate curve
  - Inversion of interest rate curve (+200 bp short term, +100 bp long term)

3 – French stress-tests on credit risk

1. Modelling macroeconomic stress scenarios

- Scenarios lead to stressed macroeconomic exogenous factors:
  - GDP
  - Private loans
  - Interest rates
- Calculated from the Banque de France's forecast model.
  - Simulation for the next two years
  - Each exogenous factor is estimated quarterly



3 – French stress-tests on credit risk

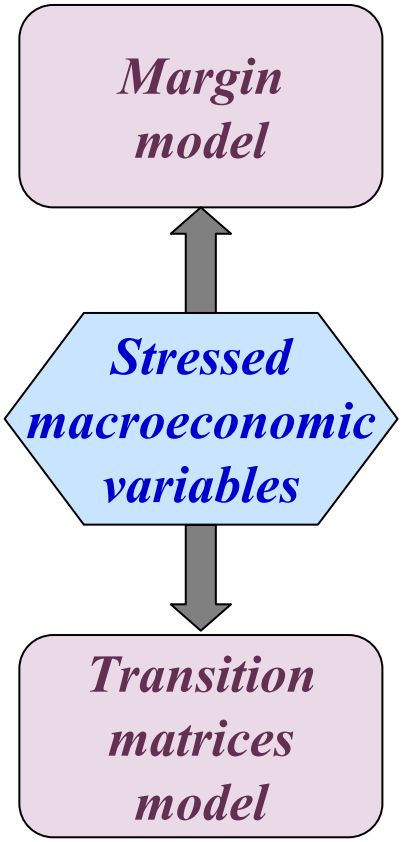
1. Modelling macroeconomic stress scenarios

- Stress variables are introduced into 2 econometric equations :
  1. A margin model, estimating intermediation margins as a proxy for banking profits, and then an approximation of the banking system results
  2. A capital requirements model, calculating transition matrices for a two-year deformation of a current credit portfolio

  Current-type portfolio is obtained thanks to:

  Banque de France's data on banks' corporate exposures (credit register)

  Distribution in risk classes (BdF ratings)



3 – French stress-tests on credit risk

1. Modelling macroeconomic stress scenarios

➢ Margin model

- Dynamic panel data model
- Structural model:

$$M_{i,t} = 0.64 + \underset{(17.99)}{0.68}\, M_{i,t-1} + \underset{(10.19)}{0.35}\, r_t^* - \underset{(-4.96)}{0.59}\, \sigma_{p,t}^{*\,2} + \underset{15.34}{0.29}\, r_t^* \Delta L_{i,t} - \underset{-0.65}{0.20}\, \pi_{i,t} + \varepsilon_t$$

adjusted $R^2 = 0.83$, OLS estimation method

$M_{i,t}$ = credit margin for bank i at time t

r_t^* = 5y - 3m risk free interest rate slope

$\sigma_{p,t}^*$ = volatility of 5y - 3m risk free interest rate slope

$\Delta L_{i,t}$ = loan growth for bank i

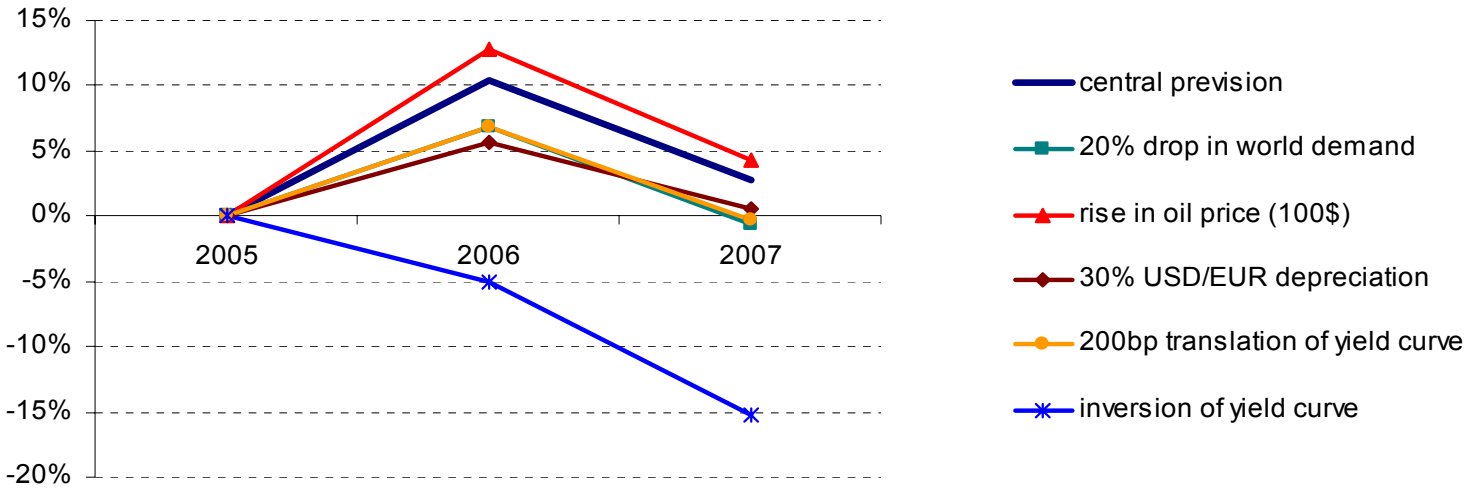
$\pi_{i,t}$ = cost of risk expected by bank i at time t

3 – French stress-tests on credit risk

1. Modelling macroeconomic stress scenarios

- Margin model

Cumulated growth of profitability in relation to 2005 level



3 – French stress-tests on credit risk

1. Modelling macroeconomic stress scenarios

➢ Capital requirements model (Risk-weighted assets estimation)

Markovian rating transition model based on observed matrix M_t :

$$M_t = \left[\Pr(rating_t = j \mid rating_{t-1} = i)\right]_{ij}$$

$$z_{ijt} = \log\left(\frac{\Pr(rating_t \le j \mid rating_{t-1} = i)}{\Pr(rating_t > j \mid rating_{t-1} = i)}\right)$$

$$z_{ijt} = \theta_{ij} z_{ij,t-1} + \alpha_{ij} + \beta_{ij} X_t + \varepsilon^p_{ijt}$$

$$X_t = macroeconomic\ variables\ (GDP, interest\ rate, etc.)$$

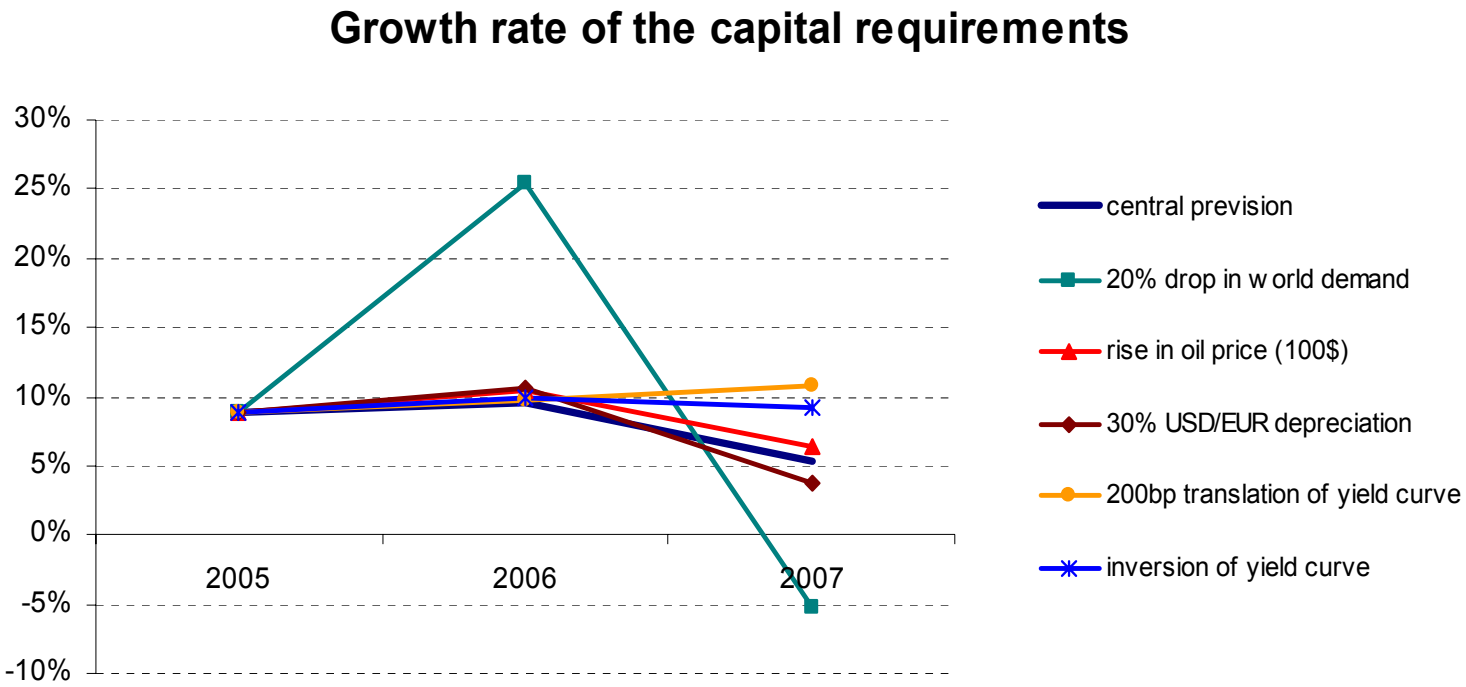
A stressed loan portfolio P_t is calculated with:

$$P_{t+2} = P_{t+1} M_{t+2} = P_t M_{t+2} M_{t+1}$$

3 – French stress-tests on credit risk

1. Modelling macroeconomic stress scenarios

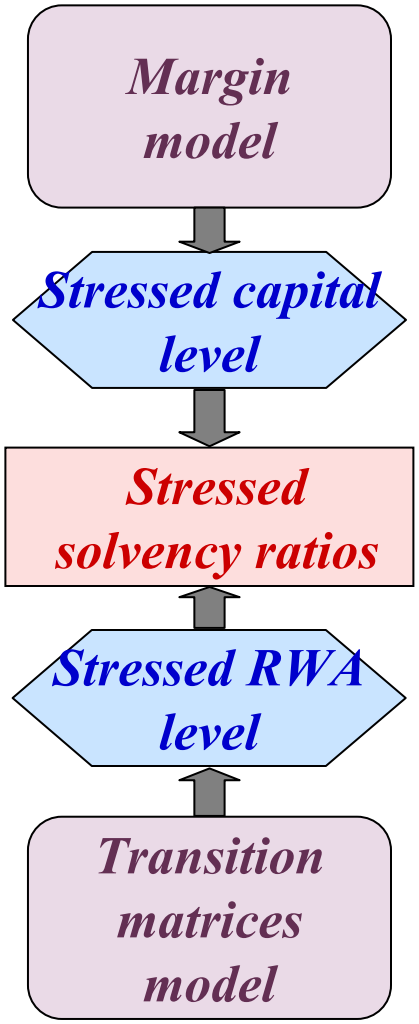
➢ Capital requirements model



3 – French stress-tests on credit risk

1. Modelling macroeconomic stress scenarios

- Final results are simulations of global stressed solvency ratios on the whole French banking system
  - The margin model calculates a stressed capital level, through the P&L account, affecting the numerator
  - The capital requirement model estimates a stressed RWA level (EL & UL for risk effects and stressed credit demand for volume effects), affecting the denominator
- These stressed simulated ratios are compared to the expected central scenario (unstressed) solvency ratio



3 – French stress-tests on credit risk

2. Ad hoc shock on a credit portfolio

- Overall or sector-specific downgrade of credit ratings:
  - One notch for all ratings
  - Or two notches for specific sectors/countries and one notch for the others

3 – French stress-tests on credit risk

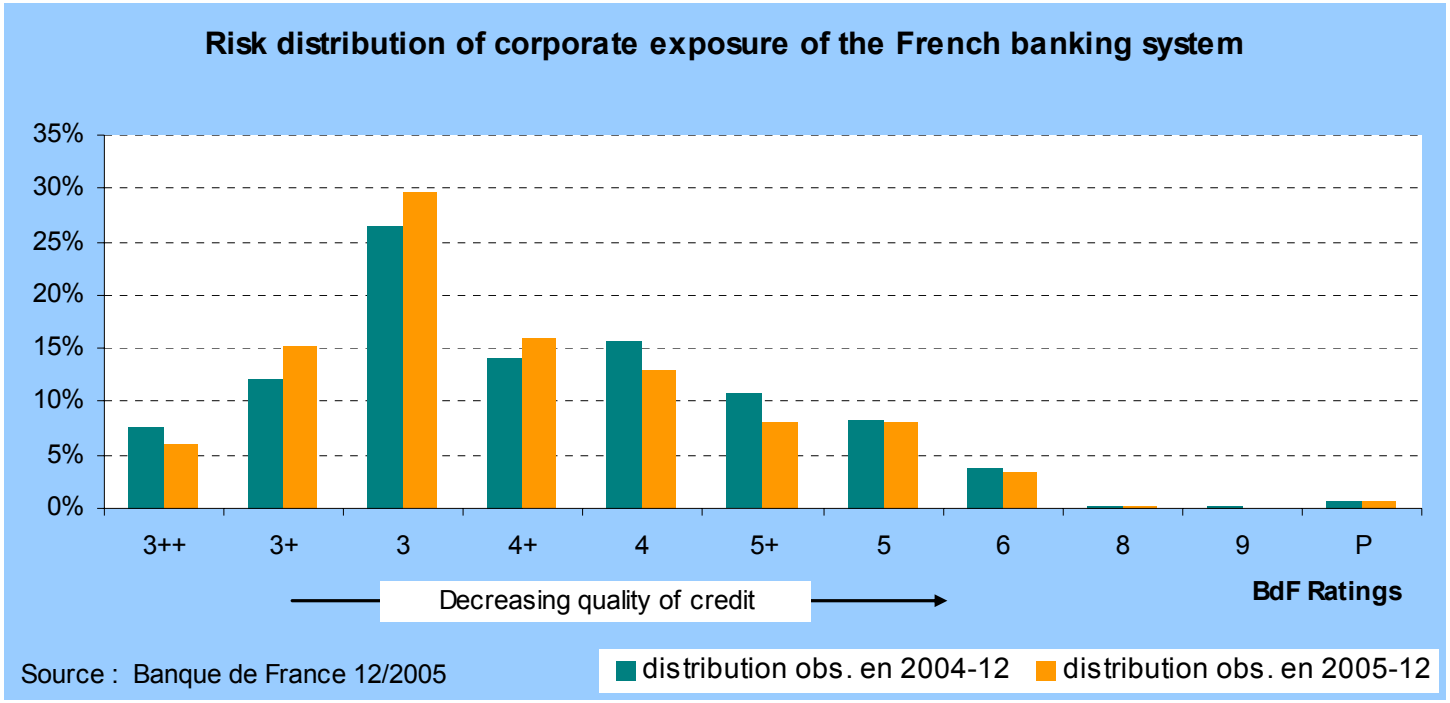
2. Ad hoc shock on a credit portfolio

- The shock is applied on the whole Banque de France's database of rated enterprises
- Using the whole French banking system exposures available in the credit register

3 – French stress-tests on credit risk

2. Ad hoc shock on a credit portfolio

➢ Risk distribution of the banks' exposures on rated enterprises



3 – French stress-tests on credit risk

2. Ad hoc shock on a credit portfolio

- A simulated overall-system stressed solvency ratio is calculated
- This stressed simulated ratio is compared to the forecasted non-stressed ratio

3 – French stress-tests on credit risk

3. Ad hoc shock on the EL of a single bank

- For an individual bank, a banking analysis tool, named SAABA 2:
  - Stress instantaneously the individual expected losses
  - Get the resulting stressed solvency ratio for the selected bank

3 – French stress-tests on credit risk

3. Ad hoc shock on the EL of a single bank

Stage 1 *: ratio Tier 1, with deductions and intern upper limit according to the regulatory ratio:*

Ratio 1 = solvency ratio Tier 1

Estimated according to Basel 2 rules

Stage 2 *: EL estimation compared to the total amount of provisions ; Tier 1 ratio imputed in case of deficit :*

Ratio 2 = Ratio 1 – net EL / RWA

SAABA 2 internal structure

Stage 3 *: credit shock simulation according to expected profits :*

Ratio 3 = Ratio 2 + [expected Profits - (stressed EL – EL)] / RWA

4 – Limits and prospects

1. Limits and future research topics

- Intermediation margin is only a proxy of banking profit
  - Modelling non-intermediation income (retail fees, prime brokerage, etc.) is a research project at the French Banking Commission
- The Mascotte forecast model aims at introducing second rank effects of the banking system stress-testing on macroeconomic parameters

4 – Limits and prospects

2. Other purposes

- The stress-testing model does not integrate contagion effects among banks yet

- In macro scenarios approach, some aspects of concentration risk on credit risk should be taken into consideration soon
  - Granularity
  - Sector concentration

5 – Conclusion

- The research work on credit stress-testing is now well incorporated in the financial stability sphere. Nevertheless, it has not reached the standards of market risk stress-tests yet, which has become common practice for several years

- International cooperation in this domain may be a good way to enhance performances in credit risk modelling