Stress Testing Credit Risk: The French experience

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Olivier Jaudoin
Head of the Banking Studies Department
French Banking Commission

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Outline

1. Introduction: FSAP Experience
2. Macro Stress Testing
3. Credit Risk Stress Testing
1 - Introduction: FSAP Scenarios

- FSAP in France in 2004
- Scenarios built by IMF / Commission bancaire / Banque de France:
  - single factor shocks (instantaneous):
    - Market type: interest rate curve, stock price, exchange rate, volatility of stock index
    - Systemic type: overall or sectoral degradation of credit spreads (ratings)
  - multifactor shocks (instantaneous):
    - Combining interest rate and stock price scenarios
  - dynamic macroeconomic scenarios (2-year horizon):
    - Drop in world demand
    - Rise in oil price (with & without reaction of the ECB)
    - Depreciation of US$ vs. €
1 - Introduction: FSAP process

Simulations implemented by banks (Bottom Up)

Expected Changes in P&L and NPL

Aggregated Changes in expected P&L and NPL

Expected Changes in CAR1 & CAR2

Simulations implemented by Supervisors (Top Down)

Aggregated Changes in expected P&L and NPL

Expected Changes in CAR1 & CAR2

Benchmarking
2 - Macro Stress Test

• After the FSAP exercise, the Commission bancaire has performed macro stress testing:
  – based on the econometric models used for the FSAP exercise
  – on a regular basis (every six months)
  – restricted to the top-down approach
    • Market type shocks cannot be implemented efficiently
  – for internal purpose
  – to assess financial stability
2 - Macro Stress Test

• Financial stability is assessed through dynamic macroeconomic scenarios (2-year horizon)

• Scenarios are built by the Commission bancaire and the Banque de France:
  – expert judgement on potential macroeconomic risks
  – diffusion of the initial shock through the in-house econometric model Mascotte and Nigem
2 - Macro Stress Test

Profitability model

- Impact of economic fluctuations on the banks’ expected profitability (net of EL)
- Use of a structural banking profit and margin model relating them to economic factors
- Structural reduced form used to test economic stress scenarios
- Analysis of banks’ stressed profits and margins as first buffer to absorb shocks
2 - Macro Stress Test

Profitability model:

- Dynamic panel data model
- Structural model:

\[ M_{i,t} = 0.64 + 0.68M_{i,t-1} + 0.35 p_t^* - 0.59 \sigma_{p,t}^* + 0.29 p_t^* \Delta L_{i,t} - 0.20 \pi_{i,t} + \varepsilon_t \]

\[ R^2 = 0.87 \]

\( M_{i,t} \) credit margin for bank i

\( p_t^* \) 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

\( \pi_{i,t} \) anticipated risk volatility for bank i
2 - Macro Stress Test

Capital requirements model:

- Transition matrix depends on the state of economy $X_t$
- Model the sensitivity of transition matrix to economic fluctuations (corporate)
- Use Banque de France ratings as benchmarks
- Element of Theory: GDP $\uparrow \Rightarrow$ creditworthiness $\uparrow$
- Goal:
  - Build a quantitative and operational tool
  - Simulation of UL needs to estimate the whole transition matrix (not only PDs of risk classes)
2 - Macro Stress Test

Capital requirements model:

- Rating transition model based on observed transition matrix $M_t$:

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

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

$$z_{ijt} = \theta_{ij} z_{ij,t-1} + \alpha_{ij} + \beta_{ij} X_t + \varepsilon_{ijt}$$
Capital requirements model:

\[
\begin{cases}
Z_t = Z_{t-1} \times M_t(X_t) + \nu_t \\
K_t = RW' \cdot Z_t
\end{cases}
\]

- Where \( X \) is a set of macroeconomic variables, and \( Z_t \) the (vector) risk distribution of the portfolio
- Model portfolio’s composition dynamic under economic shocks through transition matrix.
- Computes minimum capital requirement \( K_t \) on new risk distribution \( Z_t \).
2 - Macro Stress Test

Final analysis:

– Combination of the models
  • Assumption: RWA are unchanged when moving from Basel I to Basel II.

– Global impact on the key indicator Capital Adequacy Ratio (Basel II)
  • The CAR estimated under the baseline scenario («baseline CAR») is not a forecast of the CAR:
    – The model takes into account neither the new credit lines nor the reaction of bank induced by the shock
    – The «baseline CAR» is estimated under Basel II assumptions (capital requirements are risk-sensitive)
    – The «baseline CAR» is a benchmark
  • CAR estimated under stress-scenarios are analysed with respect to the benchmark.
3 - Credit Risk

Stress test on credit risk

– Based on ad hoc scenarios
  • Not derived from a macro-framework, since linkage « macro => micro » is difficult to establish
  • Stress assumptions directly applied to the micro-framework

– Analysis based on the corporate portfolio (through the Central Credit Register database)

– Global impact on the key indicator CAR (Basel II)
3 - Credit Risk

Credit Risk Scope:

- Static analysis
  - No feedback micro => macro
  - No reaction from banks
- The analysis is performed on the whole banking system, and on the biggest banking groups as well.
- Degradation of the creditworthiness of the portfolio (usually 1 notch)
  - Degradation with respect to the internal rating scale of the Banque de France
  - Benchmarking with other rating scales (S&P’s) and default time series.
Credit Risk Shock:

- **Instantaneous shock:**
  - increase of the average probability of default = +x% (e.g. between +60% and +90%)

- **Impact on credit risk variables:**
  - Impact on EL: multiplication of EL by (1+x%)
  - Impact on RWA:
    - we first assume that RWA are unchanged when moving from Basel I to Basel II
    - the PD associated to each rating grade is multiplied by (1+x%)
    - RWA are computed with these new PDs = multiplication of RWA by (1+y%)
Credit Risk Analysis:

- Before shock: Tier 1 ratio = Tier 1 / RWA
- After shock:
  - EL is compared to the whole provisions. Tier 1 is deducted of excess EL (if any). Otherwise, excess provisions are not taken into account (pessimistic hypothesis).
  - RWA are multiplied by \((1+y\%)\)

\[
\text{ratio Tier}1 = \frac{\text{Tier}1 - \max(0, (1 + x\%) \times \text{EL} - \text{provisions})}{RWA \times (1 + y\%)}
\]
Credit Risk Results:

- 1-notch degradation on the BDF rating scale is consistent with external and historical benchmarks.
- Tier1 Ratios remain far above 4% after shock (for any large banking groups and at the banking system level).
- Possible to stress-test specific sectors (e.g. 2 notches down for specific industries)

Open issue:

- Estimate the probability of such a shock = quantify the link between the increase of PD and the probability of occurrence
3 - Credit Risk

Improvements under way:

– Profitability model:
  • Link it to the NPL ratio and the creditworthiness of the portfolio

– Capital requirements model:
  • Estimate new credit lines as a function of the economic state
  • Test different rating scales and different definitions of default

– Try to build a panel model to estimate NPL ratio.

– Integrate these different elements into a single framework.
3 - Credit Risk

Limits of the model:

– Contagion effects are not addressed here (current exploration of large exposures data)

– No feedback: reactions from banks (re-allocation strategy) are not taken into account in the model.


Appendix: Models and Instruments (1)

Overview of Non performing loans (NPL) model – provisional

General form is linear econometrics with economic and bank specific explanatory variables ($R^2 = 0.92$)

\[
\Delta NPL_t = 0.61 \times \Delta NPL_{t-4} - 0.11 \times \Delta GDP_{t-4} + 0.1 \times \Delta IR_{t-5} + 0.03 \times \Delta Loan_{t-4}
\]

$\Delta NPL_t$  increase in NPL ratio

$\Delta GDP_{t-4}$  1 year lagged GDP growth

$\Delta IR_{t-5}$  lagged Interest Rate variation

$\Delta Loan_{t-4}$  lagged loan growth

In the process of being updated
Appendix: Models and Instruments (2)

Early Warning System SAABA

– Based on Credit Register, BdF rating scale and accounting databases.
– The general framework of the System is currently improved in order to be Basel compliant.
– Global Process :
  • Estimation of EL through estimation of PDs and LGDs
  • Impact of EL on own funds regarding SP and GP
  • Estimation of stressed Gross Operating Income
  • Calibration of an extremely negative shock
  • Estimation of the impact of the shock on the solvency ratio.
Secrétariat général de la Commission bancaire