Discussant comments on
Macro stress testing of credit risk focused on the tails
Ricardo Schechtman and Wagner Piazza Gaglianone

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“Systemic risk, bank behaviour and regulation over the business cycle”
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Discussant*: Simone Manganelli
Affiliation: European Central Bank
Email: simone.manganelli@ecb.europa.eu

* These comments reflect the views of the author and not necessarily those of the BIS or of central banks participating in the meeting.
Discussion of “Macro stress testing of credit risk focused on the tails” by Wagner Piazza Gaglianone and Ricardo Schechtman

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Simone Manganelli
DG-Research
European Central Bank
The paper

- Reduced form macro model (VAR):
  - GDP
  - Unemployment
  - Inflation
  - Interest rate
  - Credit volume

- Credit risk equation dependent on contemporaneous macro variables.
  - Credit risk proxied by non-performing loans (NPL).

- Stress testing based on bad macro scenario:
  - 1, 2, or 3 s.d. shocks to the macro forecasts of the VAR.

- Focus on quantiles of NPL:
  - Indirect: NPL is an additional equation of the VAR.
  - Direct: NPL is modelled via regression quantiles
The Model

\[
y_t = \mu + A_0 y_t + \sum_{i=1}^{m} A_i y_{t-i} + \epsilon_t
\]

\[
y_t \equiv \begin{bmatrix} \text{NPL}_t \\ \text{GDP}_t \end{bmatrix} \quad A_0 \equiv \begin{bmatrix} 0 & a \\ 0 & 0 \end{bmatrix}
\]

\[
\epsilon_t \sim N(0, \Sigma)
\]

plus additional restrictions on \( A_i, i > 0 \)
Quantile estimation

Two strategies:

**Indirect**: Estimate previous model and obtain the quantiles from the parametric distribution of $\varepsilon_{1,t}$

**Direct**: Model first equation of previous model via regression quantile:

$$Q(NPL_t, \tau \mid \Omega_t, GDP_t) = \mu_1(\tau) + a(\tau)GDP_t +$$

$$+ \sum_{i=1}^{m} [b_i(\tau)NPL_{t-i} + c_i(\tau)GDP_{t-i}]$$
Stress testing

- Assume bad realization for GDP at time T (1, 2, or 3 standard deviation shock).
- Look at the effect of this realization on the mean and quantile of NPL.
- Compare conditional (on bad realization of GDP at time T) and unconditional means and quantiles.
Comment 1: Structural VAR

\[ y_t = \mu + A_0 y_t + \sum_{i=1}^{m} A_i y_{t-i} + \varepsilon_t \]

Assume a diagonal variance-covariance matrix for \( \varepsilon_t \) and give a structural interpretation to the VAR:

Macro shocks contemporaneously affect the NPL but not vice versa.

\[ y_t = \Lambda \mu + \Lambda \sum_{i=1}^{m} A_i y_{t-i} + \Lambda \varepsilon_t \]

\[ \Lambda \equiv (I - A_0)^{-1} \]

is upper triangular
Stress testing

1) \( E(y_{1,t} | \Omega_t, \varepsilon_{2,t}) - E(y_{1,t} | \Omega_t) \)

2) \( Q(y_{1,t}, \tau | \Omega_t, \varepsilon_{2,t}) - Q(y_{1,t}, \tau | \Omega_t) \)

3) \( \Pr[y_{1,t} < Q(y_{1,t}, \tau | \Omega_t) | \Omega_t, \varepsilon_{2,t}] \)
\( \hat{\tau} \quad \text{s.t.} \quad Q(y_{1,t}, \hat{\tau} | \Omega_t, \varepsilon_{2,t}) = Q(y_{1,t}, \tau | \Omega_t) \)
**Comment 2: Quantile Simulation**

\[ y_{1,t} = Q(y_{1,t}, \tau | \Omega_t, \varepsilon_{2,t}) + \tilde{\varepsilon}_{1,t} \quad \text{where} \quad Q(\tilde{\varepsilon}_{1,t}, \tau | \Omega_t, \varepsilon_{2,t}) = 0 \]

\[
Q(y_{1,t}, \tau | \Omega_t, \varepsilon_{2,t}) = \alpha_0(\tau) + \sum_{i=0}^{p} \alpha_i(\tau)y_{t-i} + \sum_{j=1}^{m} \gamma_j(\tau)z_{t-j}
\]

For instance you could assume:

\[ \tilde{\varepsilon}_{1,t} \sim N(-k_\tau \sigma, \sigma) \quad \text{where} \quad k_\tau \text{ is the } \tau \text{-quantile of the normal distribution} \]

\[
\Pr(\tilde{\varepsilon}_{1,t} < 0) = \Pr(\tilde{\varepsilon}_{1,t} + k_\tau \sigma < k_\tau \sigma) \\
= \Pr[(\tilde{\varepsilon}_{1,t} + k_\tau \sigma)/\sigma < k_\tau] = \tau
\]

If you don’t like the normality assumption, you could use the skewed Laplace distribution.
Comment 3: Uncertainty

• Careful about the impact on risk measurement of:
  – Model misspecification
    • After the summer 2007 turmoil Goldman Sachs admitted that its models suggested their portfolios were hit by a 25 standard deviation shock.
    • This is an event that occurs once every $10^{138}$ times…
    • What was the shock implied by GS models after September 2008?
  – Estimation error (DeMiguel et al., RFS 2009)
    • Show that no estimated mean-variance model can consistently outperform an equally weighted portfolio.
    • Exercise limited to 20 assets.
    • Typical portfolio of a bank includes many more assets.
    • Attempt to model joint macro and credit risks may suffer of similar problems.

• Rules of thumb may be not too bad after all.
Comment 4: The Decision Problem

- What is the assessment? Did banks have enough capital to face the worst case scenario?
- What is the decision variable? Given your macro stress test exercise, how much capital buffer would you recommend?
- To answer this question you need first to introduce into the model:
  - Decision variable
  - Objective function
- Impulse-responses with two instruments:
  - Interest rate
  - Macro-prudential tool
- Tightening the macro-prudential tool would reduce credit risk, but what about its impact on GDP? Need to define the optimal trade-off.
- The endogeneity of the decision variables adds complexity.