Tools for Macro Stress Testing and Macro-Prudential Policy Assessment: The ECB Perspective

Discussion

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Overview

- A look at the data.
- Review main features of top-down stress testing.
- Discuss strengths and limitations.
- Some brief comments on macroprudential policy.
Euro-Area Bank Credit Spreads

Figure 1: Euro area corporate spreads for banks

[Graph showing Euro area bank credit spreads for Germany, France, Italy, Spain, and Euro area from 1999 to 2013.]
Bottom-up stress testing

- Performed at bank supervisory level.
- Based on repeated cross-section of randomized sample of individual bank loans.
- Estimate sensitivity of individual loan performance to macro-factors conditional on loan characteristics.
- Aggregate results to obtain individual bank’s loan portfolio sensitivity to macro factors.
Top-down stress testing

- Performed at country or EU level.
- Based on publicly-available bank data (e.g., Call reports in U.S.) or broad categories of asset and loan positions available to non-supervisory authorities.
- Use statistical framework to estimate the sensitivity of bank-specific variables to macro-economic disturbances.
- Generate dynamic “macro” scenario and feed into estimated model to obtain individual bank’s capital ratio response.
- Big benefit: common yardstick applied to all banks.
How can we use this for supervisory policy?

- Publish the results.
- Compare with bottom-down approach to detect outliers.
- Impose constraints on bank behavior if stress test reveals a likely shortfall under an adverse scenario.
Announcement effects after CCAR 2012
(Covas, Rump and Zakrajsek (2013))

Decline in T1CR under stress conditions (percentage points)

-4 -3 -2 -1 0 1 2 3 4 5 6 7 8
Percent

̂β = -1.0

R² = 0.51

t-stat = 4.0

Greek letters:

- β: Beta coefficient

Graphical representation:

The graph shows a scatter plot of companies with their decline in T1CR under stress conditions plotted against a linear regression line. The coefficient β is estimated as -1.0, with a t-statistic of 4.0 and an R² of 0.51.
How can we use this for macro-prudential policy?

- Gauge overall fragility of the financial system both now and in the future (forecasting).
- Consider the consequence of alternative policies that may modify the macro scenario (e.g. interest rate policy).
- Consider the consequence of aggregate capital losses for macroeconomic dynamics.
Methodology

- Generate a macro scenario.
- Translate the macro scenario into variables specific to the financial system.
- Assess the response of an individual bank to these variables.
- Feedback effects:
  - Within the financial system.
  - Within the macro system.
Real variables and interest rates: Based on medium-to-large scale DSGE model.

Asset prices: (stock market, vix, credit spreads): Based on statistical models.

Is there a link between these two?

Does the DSGE model have a financial sector?
Satellite equations

- Translate macro scenario into bank-relevant conditions.
- Single equation Bayesian forecasting approach – robust method given short samples.
- Variables:
  - Broader array of credit spreads and asset prices.
  - Country-specific: GDP, stock market, sovereign spreads, housing prices, banking conditions such as overall loan losses etc..
- Suggestion: incorporate country-specific credit spreads for financial and non-financial firms (Gilchrist-Mojon (2013)).
- Exploit panel dimension of banking data to assess response of individual bank to macro factors.
- Dissaggregated approach based on sources of income and losses.
- Reaggregate to obtain total expected capital short-fall at the bank level.
Challenges:

- Net income and loan losses are insensitive to macro factors.
- In contrast, trading profits are very sensitive to macro factors.
- Need long-time series to assess how banks perform across multiple booms and recessions.
- Portfolio strategies may evolve over time reducing value of long time series however.
\[ Y_{it} = \text{variable forecasted for bank } i \text{ in period } t \]
\[ X_{it-1} = \text{vector of portfolio shares for bank } i \text{ in period } t - 1 \]
\[ Z_t = \text{macroeconomic factors in period } t \]

The FE-QAR(p) model:

\[
Q_\pi(Y_{it} | Y_{it-1}, \ldots, Y_{it-k}, X_{it-1}, Z_t) = \\
\alpha(\pi) + \eta_i + \sum_{k=1}^{p} \phi_k(\pi) Y_{it-k} + \beta(\pi)' X_{it-1} + \theta(\pi)' Z_t
\]

\[ \pi \in (0, 1) = \pi\text{-quantile} \]
\[ Q_\pi(Y_{it} | Y_{it-1}, \ldots, Y_{it-k}, X_{it-1}, Z_t) = \text{conditional quantile function} \]
\[ \eta_i = \text{fixed effect of bank } i \]
Benefits of Quantile Approach

- Non-linearities: Both autoregressive and macro-response coefficients may depend on quantile.
- Collapses to standard fixed-effect dynamic panel data model if coefficients constant across quantiles:

\[ Y_{it} = \eta_i + \sum_{k=1}^{p} \phi_k Y_{it-k} + \beta' X_{it-1} + \theta' Z_t \]

- Conditional densities: can evaluate conditional densities of tail events associated with capital short-falls (regulators typically focus on point estimate).
Figure 2: Sum of Autoregressive Coefficients from the FE-QAR Model

(a) For selected net charge-off rates

Note: The solid line in each panel depicts—for the various quantiles of the innovation process—the estimate of the sum of autoregressive coefficients for the selected net charge-offs and components of PPNR; the shaded bands represent the corresponding 95-percent confidence intervals based on 5,000 bootstrap replications. The dashed line in each panel shows the estimated sum of autoregressive coefficients from the corresponding FE-OLS model (see text for details).
Feedback effects within financial system

- **Approach 1**: Statistical model of asset returns or CDS rates that captures conditional covariances across banks.
- **Approach 2**: Multi-level network model.
  - With rich enough data, one can compute actual network.
  - Here, rely on probabilistic network structure based on partial information – geographic location of banks.
  - Simple agent-based modeling framework to capture bilateral bank effects (loan loss spillovers).
  - Asset prices determined by adhoc formula – no forward-looking behavior.

**Result**: feedback effects magnify first-round capital losses.

**Question**: is there a way to combine 1 and 2?
What is the metric by which we judge success?
- In-sample fit versus out-of-sample forecasts.
- For the median.
- For the tail of the distribution.

What disciplines the second round effects coming from network models etc.?
Challenge: highly non-linear system for stress tests but linearized DSGE model.

Possibility:
- Sum individual bank losses and feed into aggregate bank “net worth” equation.
- This implies a shock to bank net worth.
- Recompute macro scenario, taking shock to net worth into account.
- Iterate until convergence?

This may be model-consistent if original macro scenario is determined by net worth shock to begin with.
Capital injections or Taylor-rule response to credit conditions such as leverage or credit spreads are straightforward to evaluate in linearized DSGE model and could be used to condition an alternative macro scenario for stress-testing.

- Benefits may be large due to expectation effects of future policy on current asset prices (Gilchrist and Zakrajsek (2013)).
- Benefits may be even larger if policy avoids a ”run” (Gertler and Kyotaki (2013)).

Alternative policies such as time-varying capital buffers require non-linear DSGE model (Kurmakar (2013)).
How do we model sovereign spreads in the macro scenario?
How do we model changes in bank portfolio holdings over time?
How do we model macroeconomic and policy feedback mechanisms?

- If sovereign spreads are largely driven by global factors we might not need to worry as much about feedback effects within specific countries.
Figure 5: GM banks' spreads, Banks' CDSs and Sovereigns' CDSs
3. Spreads for Peripheral European Countries*

Monthly
- Average spread
- Average predicted spread
- Contribution of global factors
- Contribution of local factors**

*Basis points

*Euro-denominated bonds for Greece, Ireland, Italy, Portugal, and Spain.
**Includes country-specific factors and bond fixed effects.
Ambitious agenda with obviously important real-world implications – it’s worth doing stress-testing properly!

Lots of thoughtful decisions for each piece of the puzzle – but we still need a pair of scissors to make them fit.

Adequately capturing feedback effects will remain a long-standing challenge.