BANQUE DE FRANCE General Secretariat of the Commission Bancaire

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Session II

Macro Stress Testing: Methodological Challenges

Discussion by Sylvie Mathérat Director, General Banking System Supervision

### **Motivation**

#### Challenges for macro-stress testing are multifaceted...

- Work on institution-based information but address system-wide stability issues
- → How to link micro-based information to a macro-prudential assessment
- Measure interdependencies within the financial sector and interactions between real and financial sector, including second round effects.
- How to better take account of individual incentives, contagion, feedback effects and how to aggregate individual reactions to shocks
- Make sure to be as consistent and comprehensive as possible, in order to encompass the majority of risks borne by banks, and take account of correlations between the different risk factors potentially affecting their balance sheets

# How to build a comprehensive framework without caricaturing excessively the different risks at stake

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## **Motivation (2)**

Recent changes in the economic and financial environment also trigger new challenges for macro stress testing

- Banks' risks assessment and supervision have to be implemented in the context of globalised markets, with large and complex financial institutions (LCFIs) whose activity is essentially "cross-border".
- LCFIs have more diversified activity and operate on complex markets and products
  - increase of non-bank activities, whose risks are difficult to capture under a traditional banking model (balance sheet approach)
  - Increased presence of non-regulated entities acting as counterparts on the financial markets
- The rapid development of risk transfer markets changes the nature of financial systems dynamics, including non-linear responses to shocks.



## **Motivation (3)**

- What has been done so far to address the policy implications of these new challenges for stress testing?
  - Basel II framework: Pillar 2 requirements to banks: develop a comprehensive stress testing framework to address different risks in an integrated manner, and relate results to economic capital.
  - Better assessment and monitoring of risk transfer markets and liquidity related issues
  - Improve knowledge and indirect regulation of non-bank actors (hedge funds (HF)) playing an increasingly important role (see FSF 2007 survey on HF, Banque de France RSF special release on HF – April 2007).

Hence, how does this translate into our task here, which is the « simulation of financial instability » and macro stress testing?



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### Outline

- All three papers address these challenges, and propose original solutions
- Discussion on the basis of the three papers presented, taken in the reverse order:
  - 1. <u>Summer</u> : builds a comprehensive framework, including different risks and accounting for contagion
  - 2. <u>Goodhart</u>: proposes a methodology to take account of banks' heterogeneity and potential interdependencies, and put this together in a synthetic Bank Stability Index
  - 3. <u>Tsatsaronis</u>: questions the validity of "traditional" relationships simulated through macro stress tests under the development of credit risk transfer markets and analyses the consecutive changes in the nature of the underlying dynamics of these relationships.



**1. A comprehensive framework for stress testing** 

Martin Summer: « Modelling instability of banking systems and the problem of macro stress testing »

- **1.1 The logic behind the model**
- **1.2 Discussion**
- **1.3 Some questions**



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#### 1.1 The logic behind the Model

#### Systemic Risk Monitor (SRM)

 was implemented by the OeNB in order to develop expertise on Austrian supervisory data for systemic purposes: the assessment of the resilience of the Austrian banking sector to different risk factors.

#### Completely integrated framework for stress testing

- Design risk factors scenarios using multivariate techniques
- Credit risk assessment: matching loan losses (non-interbank) and risk factors
- Market risk assessment: analyse the dependence between the market value of bonds and stocks held by banks and risk factors
- A Network model to include interbank knock-on effects of an initial shock measured in terms of credit and market value of individual banks' balance sheet



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#### 1.1 The logic behind the Model (2)

#### Methodology

- Balance sheet approach: book value of assets (loans, equity&bonds, interbank position) is the key data.
- The impact of shocks (risk factors scenarios) is measured in terms of losses to the initial book value of assets, after a short-term period (60 days)
- Exercise is done separately for market and credit risk
  - credit: credit register data for volumes and PDs. Estimate stressed PDs through an econometric model (macro factors). Then derive loan loss distribution.
  - market: derive loss function and losses directly from risk factor changes
- Combine results (losses) of credit risk and market risk stress testing exercises to interbank positions:
  - A matrix of banks' bilateral positions is implemented (network model: mimics the interbank market)
  - For each bank, gains and losses on the interbank market are calculated by the use of clearing positions ([asset liabilities] only for the interbank activity)
  - Changed values of loans and market position (from independent credit and market risk stress testing exercises) are combined together with interbank positions to determine, for each bank, whether it can fulfil its interbank promises or not.



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#### 1.1 The logic behind the Model (3)

#### The SRM Framework



Source : Martin Summer (2007)-OeNB



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#### **1.2 Discussion**

- Performances and advantages of the SRM
  - Efficient and manageable framework
  - Comprehensive approach embedding the assessment of different banking risks and the impact of several risk factors
  - Easy to draw policy conclusions
    - Look at simple outputs, directly extracted from the balance sheet data: Book value of loans, equity and bonds, net positions on the interbank market;
    - results expressed in terms of P&L
    - derive a "bailout cost" for the Lender of Last Resort



#### 1.2 Discussion (2)

#### Some limits (partly raised by the author himself)

#### • A structural model...

No room for simulating individual behaviour: interactions, incentives, strategies.

- ➔ difficult to tell a story about impact scenarios on the banking sector (the information content of "joint PDs" is difficult to figure out)
- →see Goodhart for an alternative approach of deriving banks' joint PDs (Part 2)
- ...based on balance sheet information

May not sufficiently reflect effective risks borne by banks: For instance, the increasing role of credit derivatives may not be apprehended by simple book value of assets

→see Tsatsaronis for a discussion of the nature of data used for stress testing exercises (Part 3)





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#### **1.3 Some Questions**

#### **A few questions...**

Do you derive, at some point, an analysis in terms of banks' solvency or do you stay at the P&L level?

- 1. If you stay at the P&L level, what is your definition of default inside of the network model, which mimics only interbank activity?
- 2. What would then be the feedback effects from the interbank market to the rest of the banks' balance sheet and to banks' solvency?
- 3. How do you compute the LLR bailing out cost?





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**2. Accounting for heterogeneity and non-linearities** 

Charles Goodhart: « A traverse from the Micro to the Macro »

2.1 The logic behind the model2.2 Discussion



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#### 2.1 The logic behind the model

- Focus on banks' interdependencies and contagion
- Objective: find a metric to better quantify banking system (in)stability.
- Hence, the logic is rather similar to the logic behind the previous paper discussed (Summer)
  - Simulate the impacts of stress scenarios on individual banks
  - Find a way to "aggregate" these impacts in a non linear way, designing a specific framework that would take account of contagion
  - The emphasis is put on the dynamics in the contagion of shocks through the banking system (default dependency)
- The methodology applied to measure "default dependency" is completely different to Summer's approach

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#### 2.1 The logic behind the model (2)

#### Methodology

1. Deriving banks' individual PDs: Bundesbank approach

- Consider the banking system as a portfolio of banks
- Each bank has a corresponding PD, that is derived from the estimate of an econometric model.
- Bundesbank model: risk factors are identified (GDP, int. rates etc.) and stress scenarios are simulated for these factors.
- The impact of the different scenarios is measured on banks' key data: loan loss provision ratio, net result etc., through an econometric model (*links macro and bank data*) <u>Common practice</u>: see Commission Bancaire's framework for macro stress testing
- Banks' individual PDs are then derived through a logistic transformation of the estimated deviation of the bank key data from the baseline.

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#### 2.1 The logic behind the model (3)

#### Methodology

2. Deriving banks' joint PDs: copulas approach

Correlation is not the right concept to take account of interdependence, in a context of non-linearities and tail events (stress scenarios, banking crises) → <u>copulas are more efficient</u> : describe linear and non-linear dependence of loss distributions, including information on both bank I and j assets, but also on the structure of their dependency

3. Using joint PDs: define systemic default:

Probability of all banks defaulting given that one bank defaults.

4. Derive a Bank stability index (BSI) such as:

"the expected number of banks defaulting given that at least one bank defaults".



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#### **2.2 Discussion**

#### Performances of the model

- Innovative approach of simulating default dependencies of banks and their implications for financial stability
- Propose a global framework to derive joint PDs for banks, make more explicit the link between individual PDs and better take into account individual features and incentives (*individual banks risks profiles embedded*).
- Address the statistical issue related to the bias triggered by correlations in computing joint PDs in the context of tail events and non-linearities





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#### 2.2 Discussion (2)

#### Policy implications and questions

- Importance of micro/macro links and second round effects in stress testing
- Contagion is the main driver of financial crises
- Necessity to rely upon reliable individual banks PDs (important role given to Early Warning Systems design)
- <u>Supervisor's interest</u>: would that be possible to draw sufficient information from that model in order to construct a "noxiousness index" for a given bank? (underlying hypothesis: a LCFI's default will have a higher impact on the systemic default than a smaller bank's default)

#### Some limits

- Too much complexity Copulas : highly computational: what happens with a system of 10 banks? (bi-dimensional copula seems already complex to compute)
- Complexity → difficulty to interpret results of stress testing exercises 18

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### 3.Credit risk transfer markets and stress testing

Kostas Tsatsaronis: « Accounting for risk transfer in macro stress-testing exercises: challenges and some (practical?) thoughts»

3.1 CRT change the functioning of financial markets and banking business

3.2 Implications for banks' vulnerabilities assessment



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#### 3.1 CRT change the functioning of financial markets and banking business

# Implications of CRT for the functioning of the financial system and the banking sector

#### 1) Policy implications

- **Positive**: increase the liquidity of individual banks and the potential for diversification
- *Negative*: create new channels through which contagion can arise.
- Nature of traditional relationships and dynamics changes: increased importance of markets expectations: indeed, origination business is much more sensitive to markets willingness to absorb related risks than the capacity of individual players to manage it.
   Contagion effects even more important

#### 2) Risk assessment: the traditional bank model called into question

- Discrepancy between the original book value of assets and the ultimate risk exposure
- Structure of banks' income changes, more emphasis being put on fee income compared to interest margins.

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# 3.2 Implications for the assessment of banking system vulnerabilities

# Analyse data at the individual level is key but not sufficient

- Bottom up approaches remain necessary ...
- ...but risk profile of individual banks is not necessarily embedded in data directly extracted from the balance sheet
   necessity to develop supervisory reports that rely upon direct assessment of risk exposures by banks

# Measuring the impact of a shock on the banking sector through balance sheet data may be misleading

- Credit derivatives: notional amounts are useless
  → go for risk exposures, as requested in COREP reporting
- Taking account of credit risk by only including the book value of loans is clearly insufficient as well (counterparty credit risk etc.)



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### **Conclusions**

Challenges for macro stress testing and challenges to banks' supervision converge

- Improving the knowledge and monitoring of individual banks' risk profiles is a major concern for supervisors and a key objective of Basel II requirements.
- Practical developments of Basel II will help supervisors in their tasks:

- Common European reporting may improve the detail and quality of information related to banks' risk exposures

- Pillar 2 requirements (banks providing supervisors with the results of their own stress testing exercises) will help supervisors in better monitoring banks' risks and better cope with contagion issues



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## **Conclusions (2)**

Contagion and banks' interdependencies are clearly a concern for financial stability actors

- Contagion and banks interdependencies is clearly the stumbling block of all the reflexion that has been generated recently in the field of macro stress testing, and the models presented here clearly have the same concern.
- The main difficulty to cope with banks interdependencies and contagion consists in finding the right balance between:
  - A good monitoring of risk profile and risk taking by individual banks, in order to limit potential contagion of individual defaults (domino effects).
  - Make sure that individual solutions to risk minimisation do not contradict the equilibrium at the system level, namely through common risks exposures that would equally expose banks to the same realisation of risk, at the same moment.



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